FLORAL RAMBLES IN HIGHWAYS AND BYWAYS

BY

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F.L.S., F.G.S., Etc.

WITH THIRTY-TWO COLOURED PLATES AND ONE HUNDRED BLACK AND WHITE ILLUSTRATIONS

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Musk Mallow.

"All Nature is but Art, unknown to Thee;
All Chance, *Direction*, which thou canst
not see."

POPE: *Essay on Man*
(Ep. I. l. 289).

INTRODUCTION

As I hope this little book will be of use to many nature-lovers in all parts of the British Isles, it is necessary to observe that many plants common in one place may be rare or unknown in another, and *vice versâ*. Hence it will be desirable not only to describe such as may be found generally scattered over the country, but occasionally special and interesting plants only to be discovered in particular counties. Thus in South-West England are some score of plants which may be called visitors from South Europe, having crossed by the Channel Islands before the British Channel existed. Others are only to be found on the tops of our mountains, their nearest continental localities being the Alps and Arctic regions. These must, of course, be specially noticed in our mountain rambles; so that wherever the rambler may wander, he may learn something of the plants afar off, which he may otherwise never be able to see growing wild.

Another fact must be borne in mind, and that is, flowers do not always appear at all times or the same time. Some blossom in one month, others earlier or later, though June and July naturally can boast of the majority; so that more than one ramble should be made over the same ground. Then, again, to find the plants in fruit, a third ramble should be made in the autumn; so that one who really wishes to make "Floral Nature Study" his or her hobby, will find plenty of enjoyment in whatever months the rambler may go out.

Merely to ramble, collect wild flowers, dry them, stick them down in sheets of paper, and get some one to tell us the names, is *not* Nature Study. It was the old style, when beginners thought they were botanists. We

now follow a far more interesting pursuit; namely, *studying* the plants and discovering how they came to be what they are. This is the only and true way to "consider the lilies of the field, and *how* they grow." In addition, we discover *why* they are growing, just where we find them, on heaths only, in marsh-land, or in the water itself, etc.

To take rambles through the country we must begin by walking down some country road or byway, and then get over the stile and cross a meadow or cornfield; and so we will suppose our rambles to commence in this way.

As many plants have interesting facts about them, space will not allow me always to describe them; so I will refer the reader for other details to be found in my little books: *Poisonous Plants in Field and Garden* and *The Making of Flowers* (S.P.C.K.); *The Uses of British Plants* (L. Reeve & Co.). Lastly, for young students of "Floral Nature Study": *How to Study Wild Flowers* (Rel. Tract Soc.). For more advanced students I would refer them to the *The Origin of Floral Structures* and to the *Origin of Plant Structures* (K. Paul, Trench & Co.); *The Heredity of Acquired Characters in Plants* is now out of print; *The Introduction to Plant Ecology* (Stanford).

Of course, Floral Naturalists—such as I assume my readers wish to be—must know all they can about the structures of flowers. There are two objects in view: the first, the most important and most fascinating pursuit, is to discover *how* every flower is specially adapted to be "pollinated," *i.e.* to receive the fertilising "pollen" upon the receptive "stigma" to ensure "fertilisation" and thereby ripe seed. This is done by the aid of insects or occasionally by birds, by wind blowing the pollen on to the stigma, or by a process of self-pollination, which recognises no external aid at all.

The other object—the only one formerly considered—is for the purposes of Classification. This is easily learnt, as we shall see.

The Last Ramble (No. XIV.) I have followed with "Rest, and Reflections." In this I have gathered

together some thoughts which the rambler may have had in his mind in a more or less undeveloped state, as being just touched upon as certain plants suggested them; while the whole of the Rambles will lead us to the final outcome of the true *Origin* of all kinds of flowering plants or "species" as we know them.

Mr. Darwin gave us, in 1859, his famous theory called —as the title of his book expresses it—"The Origin of Species by means of Natural Selection"; but in 1868 he tells us of an alternative interpretation of Evolution in his book, *The Variation of Animals and Plants under Domestication*, in which he asserts that seeds, if sown in some new and "changed conditions of life," can grow up to maturity, changing their various parts in direct adaptation to the novel circumstances, *without the aid of Natural Selection.* Darwin wrote to Prof. M. Wagner that to have overlooked this was his "greatest mistake," but he had not then (1859 and "for some years afterwards") realised the abundance of facts in support of the latter explanation of Evolution. It is a power of "Self-Adaptation" which the *Life* of organic beings is endowed with; so that they "respond" at once and adapt themselves to their environment. The new variations of structure can become "fixed" and hereditary, and are recognised as new species. The conclusion of this book will give the reader a little more detailed account of this interpretation by Darwin, which has proved to be the only true one. Darwin proposed Natural Selection solely as a *theory;* but a theory requires *proof;* and no example of a wild species having originated by means of Natural Selection has ever been found.

Dr. E. Warming, in his *Œcology of Plants* (Clar. Press, Oxford), says: "It seems beyond doubt that characters peculiar to growth-forms have arisen through direct adaptation to the environment, by a natural self-regulation" (p. 373).

G. H.

1914.

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FLORAL RAMBLES

RAMBLE I

Along a Road's Sides

Walking in the country along a main road, the first thing one cannot fail to notice is the intense struggle for existence among all the plants one sees on either side; whether we look at the grassy slopes bordering the road, or the hedge-banks and hedges upon them; or again, into the ditches below. A great variety of plants will be seen at a glance, and how they all try to get as much light as they can.

Let us first examine the grassy slopes. Of course grasses of several kinds compose them; but how came the grass to be there? In former days, when there were no good roads, the "tracks" for carriages and carts were so bad, that the drivers were allowed, when the roadway was mostly mud, to deviate into the open ground on either side. Then, hedges were subsequently made to form boundaries; so that the pasture of these strips still belongs to the frontagers; they are often enclosed by a second hedge, and used as gardens by the labourers. We still say, metaphorically, we must go "further afield" in application to any other matter, which may be too confined.

In many places the grass has been invaded by other plants, especially by such as possess creeping stems, whether they be underground, as those of the Colt's-foot,

clear grasp of the subject. I will, therefore, at once explain how plants are classified.

I will here observe, in anticipation, that the Rambler will soon find that the structures of flowers, however different they may seem to be, are all based on one simple plan, and that their distinctions are reducible to four kinds. We may name these—NUMBER, COHESION, ADHESION and FORM. To which must be added what is called the "floral receptacle," *i.e.* the modified end of the flower-stalk, which bears all the parts of a flower.

It is on various combinations of these that all flowers are classified.

Let us take, as a simple type, a Buttercup. The Rambler will probably have noticed two or three different kinds in meadows, etc. The "bulbous," with a solid globular base to the stem, and a taller kind, with deeply gashed leaves. There is another in exposed places, with "runners"; and the lesser celandine which blossoms very early with glossy leaves; for this is a "species" of the same "genus." It is known as *R. repens.*

We will take the so-named "Field Buttercup" (*Ranunculus acris*) as our type. Fig. 1 gives all the necessary details.

The flower consists of four series of parts or *whorls;* the outermost is the *calyx*, composed of five *sepals* (*b*); the next is the *corolla*, consisting of five yellow *petals;* the third *whorl* is made up of a great number of *stamens*. Each stamen (2, 2 *, front and back views) has a stalk, the *filament*, and an *anther*. The filament runs up between the two *cells* of the anther (2). These split down the sides or edges and shed a powder called *pollen*. It is this pollen which fertilises the *ovules*.

The last whorl is the *pistil*, which in this flower has a large number of separate *carpels* (3, 4, 5). Each carpel is composed of a bag-like base, the *ovary*, within which is a single *ovule* at the base (5). This will become a *seed*.

The carpel has a *style* (*b*), terminating with a rough *stigma* (*c*) at the summit (4).

When the ovule has been fertilised it enlarges, and becomes a seed completely filling the cavity of the ovary (8); the carpel dries up and forms a coat over it (7). It is now ripe, forms the *fruit*, and this kind of fruit is called an *achene*.

On cutting an achene down (8), the seed is cut through, revealing a solid white mass of reserve food, called

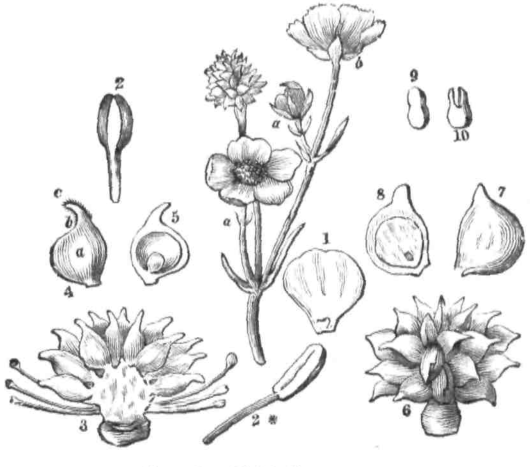


FIG. 1.—Field Buttercup.

endosperm, in which is embedded the *embryo* at the base. On removing this, it is found to have two lobes at one end (10), and a thicker part below them; this latter is called the *radicle*, and will give rise to the future root. The two lobes are called *cotyledons*, and grow into the first two leaves of the plantlet; we are familiar with them in eating mustard and cress; a tiny bud lying between them is called the *plumule*. This develops into the stem. As the embryo has two cotyledons, the buttercups belong

to the Class DICOTYLEDONS. Another class is called MONOCOTYLEDONS, because they have only one.

There is one more feature represented. What look like rudimentary leaf-blades are to be noticed (*a*). Comparing them with a perfect leaf, it will be at once seen that such is the case. Botanists call them *bracts*.

Let us now consider the uses of the different parts of the flower.

The green sepals protect the rest of the flower when immature in the bud. The bright petals attract insects, of which a great number of different kinds come for pollen and honey as food. Bees utilise the pollen mixed with honey for making "bee-bread" wherewith to feed the grubs.

I must here add a few words on this important process of *pollination* and subsequent *fertilisation* of the ovule.

It is universally necessary, but Nature has adopted three ways by which it is done, namely, by "crossing" distinct flowers by the wind, and by the aid of insects; or else by self-pollination, when the pollen from the anthers sticks to the stigmas of one and the same flower.

The study of the structures and arrangements for securing pollination is the most fascinating part of the nature student's observations. And he will find that flowers, specially constructed for certain insects, sometimes can set no seed at all without their aid, as in the orchis; but generally flowers can readapt themselves to self-pollination if necessary. The student should always study flowers with these objects in view.

Moreover, we shall find that the adaptations in flowers to enable insects to rest upon them, and get the honey most easily to a large extent lies at the foundation of classification; for this is based upon the structure of flowers, and this has been brought about to a very large extent by the visits of insects.

A pollen-grain, seen under the microscope, consists of a globular body, containing a fertilising substance called the "sperm-cell." It is the pollen-grain which, when sticking to the stigma, sends out a delicate tube which elongates until it has passed down the style, and reached the ovule at the base. It enters a small hole in the latter, called the "micropyle" (*i.e.* "little gate"). This latter contains an "embryo-sac" with a "germ-cell." The result is that the sperm- and the germ-cell are fused together, and the embryo or a rudimentary plantlet is formed.

As soon as all the ovules have been fertilised, *i.e.* one in each carpel of the Buttercup, all the parts of the flower, excepting the carpels, fall off, leaving them to ripen (6). They then form a cluster of seed-like, but true fruits, called achenes (Fig. 1, 6).

We must now proceed to examine other flowers by the roadside.

I have mentioned the Field Rose (*Rosa arvensis*) as often growing in the grass by roadsides. It differs from the Dog Rose, which is more often in the hedges, by its pure dead-white petals, whereas those of the dog rose and its ally the sweet-briar or eglantine are pink.

Moreover, the *styles* of the several carpels are *coherent* into a column projecting out of the top of the *receptacular tube;* whereas in the dog rose the *styles* are *free*.

But this requires further explanation; for the rose introduces us to a new type, by the modification of the *receptacle*.

Turning to Fig. 1, 3, it will be seen that the flower-stalk of the buttercup swells into a *knob*. Comparing this with Fig. 2, representing a section of a rose-bud, the receptacle appears as a *hollow* cup or tube. This has resulted from the margin having grown upwards, while the centre or apex of the flower-stalk was arrested. It is therefore called a *receptacular tube*. It carries the sepals, petals and stamens upon the elevated rim; whereas

the numerous carpels (which become achenes with long styles) grow upon the bottom and sides of the tube.

It is this tube which becomes scarlet in the fruit, and constitutes the so-called "hip" of the rose.

This receptacular tube is a very important feature, as it helps to distinguish groups of flowers from others, as *e.g.* it does the rose from the buttercup.

Let us compare it with that of the sloe or blackthorn (Fig. 3), so common in hedges and flowering early, before the may. Fig. 3 only differs by having a single carpel instead of many; and when ripe it becomes a "stone

FIG. 2.—Section of the Flower of a Rose.

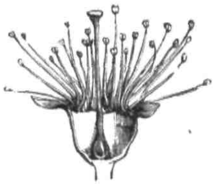


FIG. 3.—Section of a Flower of a Sloe.

fruit" called a "drupe," while the "tube" falls off altogether.

The buttercups and the roses will explain the meanings of the words *genus*, *species*, *sub-species* and *variety*. To know what a systematic botanist understands by them, we need only turn to a "Flora," such as Hooker's *Student's Flora of the British Isles*, and open it anywhere, then compare the descriptions of any two species of any one genus taken at random. It will be found that every species of such genus is known by *two* names the *generic*, as of the genera *Ranunculus* and *Rosa*, and the *specific*. Thus *R. bulbosus* is the species of buttercup with the

so-called "bulb," but it has other characters as well to distinguish it. For instance, the flower-stalk is ribbed or fluted, and not round like that of *R. acris*. Moreover, it has the sepals turned back upon the stalk, while in the latter they are spread out under the petals (Fig. 1, *b*). Several other characters might be mentioned, by which these two species may be distinguished.

Now, it will be seen that Hooker describes the root, stem, branches, leaves, flowers and fruits, noticing any special feature in each case. He thus makes a species to be recognisable by a *collection of characters* taken from any part of a plant. Some one or more features may be common to other species; but any particular species is to be known by the *totality* of its characters. The *genus* is based on similarities in the flowers and fruits.

As all characters are more or less variable when plants grow under different external conditions, botanists do not always agree as to the *number* of differences required to make a species; hence arises the different views as to what a species is in the mind of each describer. Thus as Roses and Willows are excessively variable, some call many of them "species" which others call "varieties." Hooker has adopted an intermediate position and makes secondary groups which he calls sub-species, as well as varieties differing less from each other.

These few remarks may help to remove a difficulty often felt by beginners, as to what constitutes a species, etc.

It may be here added that the usual arrangements of the families in our flora to a great extent follow what theory would maintain to have been their succession in time of their evolution. Thus the simplest condition was undoubtedly a perfect *freedom* among all the parts of a flower, as in buttercups; so this family is rightly placed first. "Cohesions" represent the next step, and we get unions between the parts of the same whorls respectively. "Adhesion" means unions between *different*

the *wing-petals* (3); while the two lowest, somewhat boat-like, are called the *keel-petals* (4). Within the last are ten stamens, nine being coherent by their filaments, the uppermost being free. This "staminal tube" encloses a single carpel with the top of the style and stigma protruding above (5). When ripe the carpel forms the pod, bearing two rows of seeds along the two combined margins of the "carpellary leaf" now changed to form the pod. The seeds or peas (6) have an embryo (7), but no endosperm. This shows the two oval seed-leaves or *cotyledons* with a little bud called the *plumule* on the right and the *radicle* pointing downwards, which will develop the root. If the reader will procure a pea or a bean, soak it well, he will easily see these parts.

The meaning of these details will be readily seen to be special adaptations to insect visitors. The honey is secreted at the bottom and *within* the staminal tube, hence is the necessity for leaving one, the upper stamen, free to allow the bee to get to it. The observer must dissect a flower, and see how the wings and keel-petals are locked together so as to form a firm landing-place. The tip of the keel-petals forms a pouch containing all the anthers, which dehisce when the flower expands. After the pouch is filled with pollen, the anthers retire downwards. The hairy tip of the style collects the pollen; so that when a bee alights on the keel-petals and wings, it depresses them, and the style sweeping it up, brings the pollen out; and then the bee receives it.

This is a good example of an irregular flower, and there is no doubt that it was descended from a regular one, for the family is allied to the Rose-family, and flowers sometimes revert to regularity.

The roadsides are often very dry, as they slope from the road towards the ditches; the consequence is that certain drought-plants or "Xerophytes," as some now call them, occur. One such is the spiny Rest-harrow (*Ononis spinosa*, Pl. II.). It has pink pea-like flowers,

as it belongs to the same family called *Leguminosæ*, because they all have pods, or legumes, *legumen* being the Latin for a bean.

The origin of the spines, which are really arrested branches, hardened into a point, just as in the sloe, wild pear, furze, etc., is entirely due to drought; for if the seeds of the spiny rest-harrow be sown in a constantly wet soil, in two years the plants raised in it become spineless, like that shown in the Figure.

There is a wild species of Rest-harrow, called *O. inermis*: *i.e.* "armless," and the one raised in a wet soil becomes identically the same with it!

The Daisy is a member of the largest family, excepting that of grasses. It is called *Compositæ* by Botanists; for the "flowers" are really "heads" of numerous "florets." Those in the middle are yellow and called "disk-florets," and those on the circumference are white, and are named the "ray-florets." The former have tubular corollas, the ray having a short tube below, but spreading limbs.

"The simple daisy was once a flower of great renown, and was called in England, either herb Margaret or Day's-eye: and it still bears the name of Marguerite. in France. It was the device of the unfortunate Margaret of Anjou, and when that queen was in prosperity, her nobles wore it in wreaths in their hair, or had it embroidered on their robes. That noble-minded woman, Margaret of Valois—the friend of Erasmus and Calvin—she who could retire from the admiration and glitter of courts, to study her Bible, and her own heart—she too had the daisy flower worn in her honour, and was called by her brother Francis I. his "Marguerite of Marguerites." *

It was called bone-wort in the middle ages, being used as a medicinal drink. Both Daisy and Plaintain together with some forty-eight plants were made into an ointment for sores arising from a broken bone.

* *Wild Flowers of the Year*, p. 24 (R.T.S.).

Thus Chaucer wrote in *The Knight's Tale* :—

> "To othre woundes, and to broken armes
> Some hadde salves, and some had charmes,
> Fermacyes of herbes, and eek *save*
> They drunken, for they wolde [t]here lymes have."

This drug called "save" supplies a good illustration of the many different plants that were often used for recipes. It required no less than *fifty!* The daisy was then spelt "dayseyze." *

We shall find some composites with larger heads elsewhere and easier for examination. In the mean time take a dandelion "head," and it will be soon seen that there is in this plant no distinction between the ray and disk-florets. It will scarcely require a lens to see the following details. Cut a head down through the middle, and pick out a floret. It has an ovary below, somewhat oblong by mutual pressure; a short joint, as it were on the top, carrying a circlet of bristles. Within these is the yellow corolla, consisting of a five-pointed strap, but terminating below in a tube. Within this will be seen five stamens; their separate filaments arising from this tube support five long, yellow anthers *coherent by their edges* into a little cylinder. Up the middle of this rises the style. (See Fig. 25.)

The pollen is shed into the anther-cylinder, the style, with its two tongue-like stigmas closely pressed together, grows, and by so doing *pushes the pollen out* at the top, the grains clinging in a cluster to the under-, *i.e.*, the *wrong side* of the stigmas. These now spread out widely, ready to receive pollen brought to them; but if none arrives, the tips curl backwards, looking like ramshorns, and so dip the *upper side* of the stigmas among the grains. It thus pollinates itself.

Let the reader examine several florets in different stages of development, and he will soon discover the

* *Medical Werkes of the Fovrteenthe Centvrye* (G. Henslow).

above details for himself. The florets on the circumference open first, and others progressively to the centre.

The bristles represent the calyx; for the ovary is really invested by a receptacular tube *adherent to it*. When this is the case the ovary is said to be "inferior," and calyx, "superior."

When the fruit is ripe, the corollas all fall off; the little "joint" below the bristles, *i.e.* the continuation of the receptacular tube, elongates. The bristles spread out horizontally; while the fruit being easily detached, floats away on the breeze. This ring of hairs or bristles is called the *pappus*.

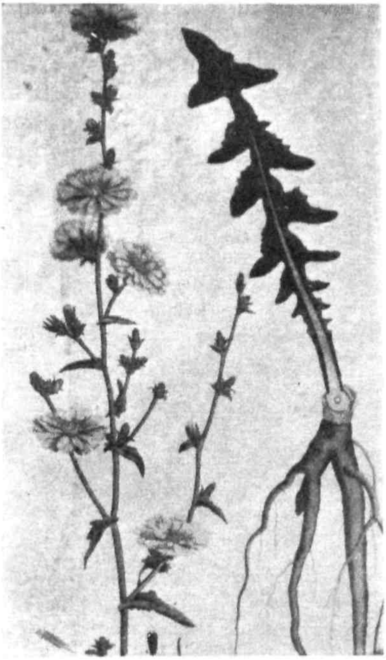


FIG. 4.—Chicory.

The chicory (*Cichorium Intybus* (Fig. 4)) is not an uncommon wayside plant. It has a stiff stem, some three feet high, with branches and blue heads resembling in form those of the dandelion; but the chicory has no pappus, only small scales on the top of the seed-like fruit.

The chicory of commerce is made from the cultivated plant, which forms a parsnip-like root. This is roasted and ground to powder. When the leaves of young plants are blanched, they are used for salads.

The Tansy (*Tanacetum vulgare*), a "composite" with a stem two to three feet high, and yellow heads, but no conspicuous ray florets, and grouped in flattish clusters, occurs somewhat locally by roadsides. As it was formerly cultivated it may be naturalised only. The outer or ray florets have pistils only, the disk florets being staminate without a pistil. It was grown in gardens for seasoning and used medicinally as a tonic and febrifuge. The flowering tops were the part used, like those of the chamomile. Gerard, in his Herbal (1597), says it was used in cookery, that cakes were made of the young leaves in the spring, mixed with eggs, which were called tansies, "which be pleasant in taste and good for the stomache; for if bad humours cleave thereunder, it doth perfectly concoct them and carry them off. The roote preserved in honie or sugar, is an especiall thing against the gout, if everie day, for a certaine space, a reasonable quantitie thereof be eaten fasting."

The reader is probably familiar with our cultivated garden Balsams: but we have two, one native, the other naturalised, in England. The former (*Impatiens noli-me-tangere*, Fig. 5), which we may translate, "I'm *impatient* to burst, so *don't touch me;*" for, if the pod is ripe, and gently pressed, it explodes, by the valves suddenly coiling up, and scattering the seeds to a distance as shown in the illustration. It has yellow flowers over an inch long with a "spur" on one of the sepals. It is wild in North Wales and Westmoreland. I found a single plant on the roadside near Barmouth in 1863, on the south side of the river. It was recorded as growing in the same place in 1834.

The orange-coloured species (*I. fulva*) is a North American plant, but now quite naturalised in several places by rivers. *I. parviflora* is only a garden escape. It has very small yellow flowers.

St. John's-wort (*Hypericum perforatum*) is common by hedge-banks, roadsides, etc.; and may be taken to

represent the genus, of which we have eleven species. They all have opposite leaves, and sometimes, as in the present species, have pellucid glandular dots, when held up to the light. They suggested the specific name, as if they were holes. The yellow petals are peculiar in not

FIG. 5.—Balsam.

being quite symmetrical in shape; while the stamens appear to be numerous, but they will be found to be united in three, sometimes five, distinct bundles.

They mostly abound with a yellow resinous juice, of a lemon scent, if rubbed with the fingers, while at the same

time staining them purple. People in former days used to gather this plant with great ceremony on St. John's day, and suspend it in their window as a charm against evil spirits; hence it was called *Fuga demonum*. In Scotland it was borne on the person as a charm against witchcraft.

The little Knotgrass (*Polygonum Aviculare*) is everywhere by roadsides, fields and waste places. It is a prostrate plant, with very small green flowers, as it has only a calyx and no corolla, but the five sepals are tipped with pink. There are generally eight stamens, but sometimes less. They arise from a shallow receptacular tube or rather disk. The pistil has three carpels, with a one-celled, one-seeded ovary.

It is an interesting plant as showing how it changes its form according to the locality in which it happens to grow; so that there has been distinguished a "shore," a "maritime," a "field," and a "wayside" variety. Each of these has been described as a species or variety by different botanists. Those by the sea are marked by fleshiness, which is due to their imbibing salt.

The flowers are degraded, having no corolla, and no honey. The anthers and stigmas mature together, so it is a good type of a regularly self-pollinating flower; and such are always the most abundant, as they set seed profusely.

A common weed by the roadside is a species of *Potentilla* (*P. anserina*, Pl. XII.). It is called Silverweed, from the white silky hairs on the surface of the leaves. Much hair is often a characteristic feature of plants growing in a constantly dry situation, for if the silverweed is found in a damp shady lane, the upper surface of the leaf is almost hairless and dark green in colour. The flowers are of a golden yellow; the structure agrees with that of a strawberry, but the receptacle does not swell into a succulent body. (See Fig. 92.)

The sweet-scented Agrimony (*Agrimonia Eupatoria*,

Pl. III.) is common by roadsides, and the borders of fields. It has pinnate leaves, and small yellow flowers, in terminal spikes. It has a hollow spiny receptacular tube, like the rose, carrying the sepals, petals and stamens on the rim, with two carpels only within the tube. The plant has long been used for making a herb-tea. It is slightly bitter and astringent, but aromatic. The scent has been likened to that of the apricot, especially when bruised. The Indians of North America and the Canadians were said to have employed the root in burning fevers. The plant will dye wool a nankin-yellow colour, and it has also been employed in the dressing of leather. It belongs to the Rose-family; but it is more allied to the strawberry and Potentillas of that family.

We have two species of Avens. The commonest (*Geum urbanum*) grows by roadsides. It has long interruptedly pinnate leaves; *i.e.* the leaflets are of different sizes. It grows to about three feet in height, and belongs to the Rose family, as it has a small receptacular tube, like that of the Agrimony, but the achenes bear a style which makes a bend in the middle; and when ripe, it becomes stiff, the upper part breaking off, while the lower part now forms a hook, so that these hooks catch into anything that it can hold, as sheep's wool, and so the seeds get dispersed.

The Water Avens (*G. rivale*) grows by streams, and has a red-brown calyx and yellow petals. The roots of both kinds were formerly employed for flavouring, etc.

RAMBLE II

By Hedges and Ditches

Let us now turn to the hedges and ditches. The former are generally made of hawthorn or "quick-set," as it is called, for cuttings planted soon grow up into a hedge. The herbs on the sides of the ditches or on the hedge-banks, clothe the lower parts. They are very various, such as the stinging- and dead-nettles; with the lords and ladies or cuckoo-pint, otherwise called the Spotted Arum. The ten-rayed, white-flowered Greater Stitchwort (*Stellaria Holostea*, Pl. IV.) is very abundant in early summer. These and others are all trying to crowd each other out in the incessant battle for life.

How does the delicate Stitchwort manage to hold its own and thrive among the above rough customers? It is a perennial, unlike its little ally the Chickweed, with tiny star-like petals. Hence their Latin name from *stella*, a star. It is because the leaves are narrow and spreading upwards like grass; so it can escape being overshadowed by other broad-leaved plants.

An unobservant rambler might easily imagine that it had ten petals, as the five are so deeply cleft. With regard to its pollination by insects, there are three stages. In the first the outer stamens in front of the sepals, where the yellow honey-glands are, stand close to the pistil, with their dehiscing anthers upwards, while the stigmas are immature. In the second stage the other five stamens shed their pollen. In this stage the stigmas

have elongated, and ultimately curl outwards, bringing the surface upwards; at this period the anthers have mostly pollen; so that the whole process favours crossing rather than self-pollination. Nevertheless, as in many similar cases, self-fertilisation is not excluded; for, as Müller observes * (from whom the above details are abbreviated), the ends of the stigmas, as they spread outwards, often come in contact with the inner anthers still carrying their pollen.

The Rambler must always examine flowers for himself and verify this and other descriptions given from time to time.

The Dead-nettle (*Lamium album*, Pl. V.)—so-called because it has no stings, though the leaf is much like that of the stinging-nettle—is one of our commonest of hedgerow plants. By understanding the structure of the flower, the reader will have a key to many other plants; for we have seventeen *genera* of the same "lipped" family (*Labiatæ*), from the Latin word *labium*, a lip. In other rambles we shall meet with the corn-mint (Pl. XIV.). Water-mint, the pepper-mint, and in the West of England the horse-mint, the probable origin of the cultivated mint of gardens, affect moist places.

Again, there is the sweet-scented Thyme (Pl. XX., Fig. 61), Marjoram and *Salvia*, of which the garden Sage is a species. No member of the family is known to be poisonous.

Now let us examine a flower of the dead-nettle. There is a tubular calyx with five points, to support the corolla, which has a weak tube with a large lip in front as a landing-place for humble-bees, and a hood at the back protecting the four erect stamens. There ought to be five, but the one at the back has been suppressed. The four anthers grouped together look forwards under the hood, while the style bends over and holds out its two

* *The Fertilisation of Flowers*, p. 135.

stigmas like little tongues as shown in the section (1). When a bee alights on the lip or landing-stage prepared for it, she bends her head towards the back while passing her tongue to the bottom of the tube, where the honey is to be found on the anterior side. In doing this the pollen gets deposited upon the head or back. Thus, on entering another flower the tongue-like stigmas lick it up. The student must verify all this with a living plant. This procedure is common to many other plants not belonging to the *Labiates*, as the Fox-glove, Snapdragon, and others belonging to a different family having the apallingly long name *Scrophulariaceæ!*

The two stigmas indicate two carpels, but as there are only four ovules, the ovary is folded round them; and adheres to each seed and breaks into four separate "nutlets" (2).

The living plant must be thoroughly examined. It shows why "irregular" flowers are almost always close, and with their backs, to the stem; for the insect can only visit them from the front. The ancestral flower was undoubtedly regular, a sort of equally five-lobed trumpet in shape. It not infrequently occurs in the Labiates. But it has developed into an irregular one by response to insect visitors.

Several garden flowers, irregular in the wild state, have reversed the process and become regular, forming a circle in outline under cultivation, as pelargoniums, pansies, gloxinias, etc., presumably because no insects visit them in greenhouses. That irregular flowers have arisen in adaptation to insect visitors, *i.e.*, by *responding* to the mechanical forces exercised by them cannot be proved *experimentally;* but the *facts* are that thousands of correlations of structural details in flowers with the size of the insect can be seen. Take as example the flower of a *Duvernoia* (Fig. 6). Looking at (*a*), and supposing we knew nothing of the intercrossing effected by insects, we might well ask, what is the use or meaning of the

great irregularity of the corolla? Why and how has it come into existence? No answer is forthcoming. Now, turning to (*b*) we can at once see its adaptations. The weight of the bee must be very great; but the tubular structure of the base, and the curious shape of the lip of the corolla, with its lateral ridges, firmly gripped by the bee's legs, is evidently not only an excellent landing-place, but is so constructed as to be best capable of supporting the weight of the insect, which can thus secure an excellent purchase, while rifling the flower of its treasures.

Besides the corolla, the anthers and stigmas arch over the orifice, and are so placed as to strike the bee on the thorax at the same spot. Moreover, the honey is secreted just where the bee can most readily get it while the anthers are depositing the pollen upon it. Lastly, the calyx-tube strengthens the base of that of the corolla just where it would be likely to bend under the weight of the bee.

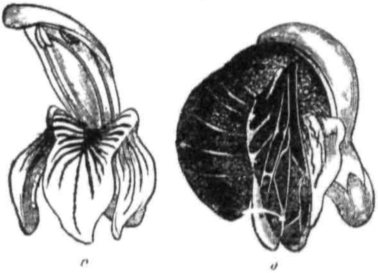


FIG. 6.—*Duvernoia.*

The above is only one out of thousands of cases in which *express purposes* are obvious in the numerous *details* of a flower; every one of which adds its share to the totality comprising the special adaptations of any particular flower. When the *orchis* is described, we shall find far more complicated structures, every one of which has its own definite use or purpose in enabling the insect visitor to get all it wants for itself, but at the same time it pollinates the flower.

The argument of "self-adaptation," therefore, rests on a vast accumulation of facts, all conspiring to establish the *probability* of its truth. This is called *Inductive Evidence.*

There may be often observed clumps composed of the leaves of the Cuckoo-pint, or Lords and Ladies (*Arum maculatum*, P. VI.), abundantly by the sides of hedges. The illustration gives the details of this curious plant. The blade of the leaf resembles that of the aquatic Arrowhead, and like it, bears leaves with the earliest blades of an oval form; for it was doubtless ancestrally an aquatic plant. (See Fig. 51.)

The pale-green structure is really a large bract called a *spathe*, which includes the flowering stem or *spadix* (5). This carries perfect pistils (*p*) at the base, imperfect ones, or abortive bristle-like pistils (2, *ap*). Above a short interval are numerous stamens with four-celled anthers (1, *st*). Above them are a few more abortive pistils, with stiff styles making a barrier, so that if flies can get down the spathe, they have a difficulty in escaping. Each fruit consists of a single scarlet berry, many being crowded on the stalk (4).

The margins of the spathe strongly overlap one another, and being contracted just where the bristles radiate from the spadix, they thus form a closed trap; the purple spadix is a guide-post to insects which enter and make their way through the bristles down to the expanded part below. Six different kinds of flies have been found within it; sometimes hundreds are caught. An observer writes: "I could often see, on looking down through the grating, that many of the prisoners were trying to fly upwards to the light, and falling backwards, or trying to crawl out and being repulsed by the sharp points. Whenever I broke open a spathe in the third stage of flowering, I always found a multitude of inmates groping about in the thick layer of pollen on the floor of the chamber." *

All parts of the plant are poisonous, as they contain a deleterious juice, which is dissipated by drying. Children have died from eating the fruit. Good starch

* *Fertilisation of Flowers*, by H. Müller, p. 563.

can be extracted from the tubers, which was formerly sold under the title of Portland Sago, in Dorset. It was also called "starch-wort," * as it was used for stiffening the cuffs and frills worn by gentlemen and ladies in the reign of Queen Elizabeth. Gerard in his *Herball* (1597) says: "The most pure and white starch is made of the rootes of the Cuckoo-pint [now called Lords and Ladies as well]; but most hurtful for the hands of the laundresse that hath the handling of it; for it chaffeth, blistereth, and maketh the hands rough and rugged, and withall smarting."

Gerard had no microscope; but if a drop of juice be examined, it will be seen to abound with minute sharp-pointed crystals of oxalate of lime. Not only are they mechanically hurtful by their sharp points, but oxalic acid is a poison. It is the substance of "salts of lemon" for removing inkstains. It also occurs in rhubarb and woodsorrel.†

Violets (*Viola odorata*), of course, abound in all shady, moist places, as on hedge-banks, etc. The flower has some interesting features. The five sepals have "flaps" behind the point of attachment to the stalk. Of the five petals, one has a hollow "spur" for collecting the honey; the anthers form a cone round the pistil; two in front having honey-secreting appendages, which dip into the spur. The stigma consists of a sort of hook, projecting forward in front, so that "when a honey-seeking insect thrusts its head or proboscis beneath the stigma it pushes up the pistil and opens the conical ring of anthers; the pollen is thus shed upon the inserted organ. Thus in every flower the insect touches first the stigma, and then causes the shedding of the pollen" (Müller).

It is remarkable that the large sweet-scented flowers of the violet rarely set any seed in this country; but if

* "*Wort*" like "*grass*" *was used formerly to mean simply* "plant."

† For remedies against poisoning by *Salts of Lemon*, see my *Poisonous Plants of Field and Garden*, p. 143. (S.P.C.K.)

the leaves be lifted up *after* the flowering season is over, numerous buds will be seen below them. These never open, but, nevertheless, set an abundance of seed. The figures (Fig. 7) will explain what takes place: the long style is not developed, but the anthers all lie flat (*g*) upon the stigma or the top of the ovary (*d*). The anthers do not burst to let the pollen grains out; for these develop tubes which bore through the wall of the anther and so get to the stigma (Fig. 7, *f*).

In some warmer climates, as Italy, these "cleisto-

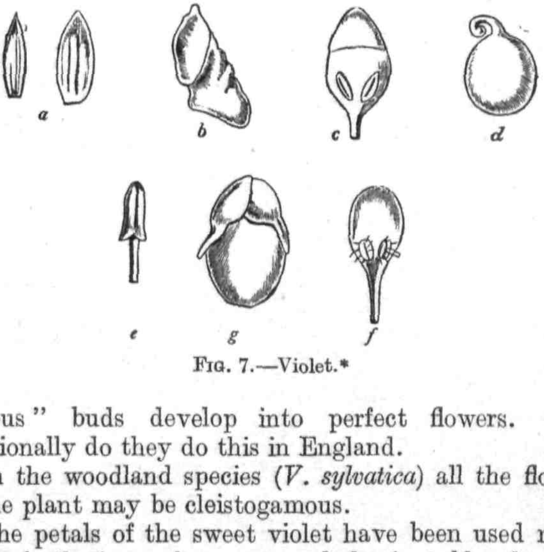


FIG. 7.—Violet.*

gamous" buds develop into perfect flowers. Only occasionally do they do this in England.

In the woodland species (*V. sylvatica*) all the flowers on the plant may be cleistogamous.

The petals of the sweet violet have been used medicinally in the form of a syrup, and also for a blue dye. It would appear, from old records, that it was used as a substitute for woad for adding beauty to the ladies of the period.

The yellow Toad-flax (*Linaria vulgaris*) is common, but does not blossom till the autumn. It resembles the

* *a*, petals; *b*, a petal as spur only; *c*, *f*, stamens; *e*, bud.

snap-dragon, having a closed mouth; but while the latter has only a little pouch at the base of the corolla-tube, for holding the honey, the toad-flax has the same part prolonged into a spur in front. Otherwise the structure is the same.

This plant is interesting, as the flowers may sometimes be found with three or even five spurs. The spur in front only was the original adaptation to insects, but this has "spread" to the other five petals. The name *Peloria* was given to it, a word meaning "monstrous," and so this term has become applied to any other such exceptional formations of flowers, as the green rose, double flowers, etc.

The fruit of the toad-flax is a two-celled dry capsule, bursting at the top by forming "pores," through which the seeds are liberated.

One of the commonest herbs by hedge-sides is called Garlic-mustard or Sauce-alone, and also Jack-by-the-hedge (*Sisymbrium Alliaria*). It has rather large, coarsely toothed leaves and small white-petalled flowers. It often grows to about three feet in height. It is also recognised by its strong smell of onions (*Allium*, an onion), hence its names. The origin of the last name is obscure; but the late Dr. John Lindley, a celebrated botanist, some eighty or more years ago, was dubbed by his youthful companions, when a young botanist, "Jack-by-the-hedge" as he was hunting for wild flowers!

The Black Mustard (*Brassica nigra*) is apparently wild on sea-cliffs and in the hedges, as at St. Ives, Cornwall. It has dark brown seeds; while the white mustard (*B. alba*) has yellow-coated ones. When found wild it is probably an escape from cultivation. It is the one usually grown for salad with cress.

One of the most interesting groups of plants to be especially seen in hedges are those which, in the struggle for life, have acquired the habit of climbing. By this means they easily get to the top of the highest hedge, as ivy will cover the tallest tree, though it climbs by means

of adhesive roots and not like the hedge climbers. These mostly manage the process by twining their stems spirally round others. Such are the honeysuckle, woody nightshade, hop, convolvulus and the Black bryony (*Tamus communis* (Fig. 8).

FIG. 8.—Black Bryony.

Those which climb by means of tendrils are the meadow pea (Pl. I.), the vetches (Pl. IV.) and the true Bryony (Pl. VII.).

The Cleavers (*Galium Aparine* (Fig. 9), also called goose-grass, the dog-rose and blackberry are rather to be called scrambles, as they are aided by hooked processes, as thorns, etc.

The origin of stem-climbers or twiners is as follows :—

When seeds of non-climbing plants growing in the

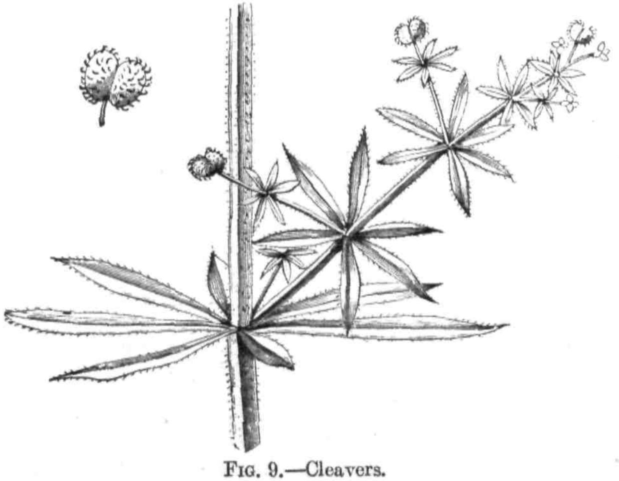


FIG. 9.—Cleavers.

open in full sunshine happen to fall in very shady places, as woods and forests, they germinate, but to reach the light, the stems get "drawn," or elongated towards the source of light.

The stem, moreover, is continually "circumnutating," as Darwin called it. That is to say, it "bows around" with a sort of rolling motion, the tip describing a circle or ellipse in some hours. Now, if it comes in contact with another stem or twig, this bowing motion compels it to twist round the supporting stem in a spiral manner. It can be easily imitated with a piece of string and a stick.

If a non-climbing plant, as a bean or, as I tried it, a periwinkle, grows in nearly total darkness, having a slender stick fixed near it, after a short period of growth, the stem will be found growing in a loose spiral about the stick.

The Ivy is ubiquitous, on walls, trees, or on the ground, as banks, etc., which can be covered with it. It is a root-climber. That is to say, although rooted in the ground the stems and branches send out horizontal climbing adhesive roots, which adhere to the support by their cells flattening out upon them. The shoots turn to the darker side, as may be seen when ivy reaches the top of a wall, from *both* sides; wherever the sun may be the shoots lie flat upon the top. The roots themselves only come out from the darker side of the shoots, so that both of these acquired habits have their purposes. When the ivy is going to flower, the shoots *now* turn to the light and stand out freely into the air; moreover, the form of the leaf changes from a five-pointed one to a much smaller oval type. As the shoot now has to support itself, if a section be made and compared with one of the same diameter which is supported by the adhesive roots, it will be found that it has put on more wood with less pith, than in that of the supported stem. It at once, so to say, *feels* the strain and makes wood sufficient to meet it.

The flowers are small and green, with an inferior ovary,

bearing a honey disk on the summit. It ultimately becomes a black berry.

The form of ivy which creeps over the ground on banks and in woods, etc., never blossoms. The branches root into the soil, but they are of the ordinary kind deriving nourishment from it. On endeavouring to train this kind on a wall, it was found to have practically lost the power of climbing; for it continually kept falling away from the wall instead of adhering to it; just as cucumbers refuse to climb by their tendrils, if the stem and branches be supported artificially, as stated below.

Tendril climbers have certain organs converted into highly-sensitive climbing structures. Thus, those of the pea are modified leaflets of the compound leaf. In the pea (Pl. I.) it is the terminal leaflets. In vetches (Pl. IV.) other leaflets become tendrils. The whole tendril usually circumnutates, so that when their hooked tips catch twigs, these at once arrest the movement, and the branches of the tendril coil themselves round their supports.

Most of our species of Vetches are tendril climbers, and several are to be found on hedges as the one figured (*Vicia sepium*, Pl. IV.). They have compound leaves with many leaflets, some being changed into tendrils,

The common vetch of cultivation is *V. sativa*, and is only found wild as a casual escape. It is also called Tares. It must not be confounded with the Tares of the parable; for that is a grass called Darnel, and will be described in our ramble through a cornfield.

In some plants it is the flowering branches, as of vines and the Virginia Creeper, which have been converted into tendrils. An inspection of any vine in summer will generally show some tendrils with buds upon them, revealing their origin. Occasionally what *ought* to have been a tendril becomes a flowering branch and bears a full bunch of groups. The two together are called a "double cluster."

Our Bryony (*Bryonia dioica*, Pl. VII.) is a common

hedge-climber belonging to the cucumber family. It has a very curious way of climbing. It first throws out long, straight, slender, almost thread-like tendrils, only curling at the tip. It "circumnutates," *i.e.* keeps bowing in circles, searching for something upon which it can hook itself. As soon as it seizes a twig, being highly sensitive to touch, the tip coils tightly round the twig. If the short tip of the coil cannot complete a second coil, the whole tendril becomes slack by the shoot bending *towards* the coil. This is probably due to the shoot itself, from which the tendril arises, circumnutating. The tip of the tendril is then able to make a second coil round the twig. But this is by no means all. A strong wind might easily snap the tendril in two. It must be greatly strengthened. To do this and to give it considerable "play" so that it can yield to a strong wind, it proceeds as follows:—

At a short distance from the base of the tendril, this makes a curve or bend, which soon becomes straight, being about half an inch long. This straight bit now *revolves like a crank!* The consequence is that the tendril becomes spirally twisted, like a corkscrew, but in opposite ways on either side of the crank. If the portion near the caught twig requires to be strengthened, a second, or even a third crank may be made. The tendril at the same time must increase in thickness; so that all strains are perfectly met.

I grew some cucumbers, training them up a wall, by tying the shoots and branches to horizontal wires. The plants soon discovered that they need not support themselves; and although I placed the hooked tips of the tendrils over the wires, not one would grow or coil around them!

With regard to the structure of the flowers of the common Bryony, it has male and female flowers on different plants. The female flower (2) has a minute green calyx growing from the circumference of a receptacular

disk. The corolla has five green petals. The three carpels are indicated by the three stigmas (2). They make a globular ovary, but this has an unusual internal structure, better seen in a thin slice of a cucumber.

The central column carrying the ovules in two rows in each of the three cells of all ordinary trilocular ovaries, as of a blue-bell, tulip, etc., is due to the six margins of the three carpels meeting in the middle, the sides of the carpels being coherent; as if one took three pea-pods, put the three edges together, *i.e.* at an angle of 120 degrees between each, then compressed them until the six sides were flat in pairs against one another.

Now, to increase the surface for bearing ovules, the ovule-bearing margins of the Bryony first meet in the middle, but *do not unite* there; they continue to grow by turning outwards; so that they give the appearance of anchors when cut across, and the ovules are borne by the edges, now carried near to the circumference. A thin slice of a cucumber will readily show the above details.

The root sometimes grows to an enormous size, some feet in length and thick in proportion; as it is generally forked, it has been called—and sold as—the Mandrake, a species of *Atropa* allied to our Deadly Nightshade (*A. Belladonna*, Fig. 35), but the leaves and flowers of the two plants are totally different.

In the male flower there appear to be three stamens; but they are coherent, thus, $2 + 2 + 1$ (1), they bear "sinuate," or S-like, anthers. The fruit consists of scarlet berries. The plant is very poisonous. It was called wild Nep or Nepte in the Middle Ages, and formed with hemlock juice, opium, henbane and vinegar, a drink to send a patient to sleep for surgical operations. It was probably found to be so dangerous, that no record of its use is known later than the fifteenth century.

The following is the full recipe for this anæsthetic used in the Middle Ages—

"For to maken a drynke that men calle dwale, to

make a man slep-en whyles men kerue [hence, "carve," cut] hym. Take the gall. of a borwswyne and iii sponful of the Ius of humloke, and iii sponful of the wylde Nep and iii sponful of letuz, and iii sponful of pope [poppy] and iii sponful of henbane and iii sponful of eysylle [vinegar]. Medle [mix] [t]hem alle to-gedere and boille hem a litil, and do hem in a glasen vessel wel stoppede, and do ther-of iii sponful into a potell of good wyne or good ale and medle hem wel togedere, til it schal ben noted; and thanne [then] lat hym that schal ben curuen sitte ageyne a good fyre, and make hym to drinke ther-of till he falle on slepe. And thanne men may safly keruen hym, and whanne [when] he hathe ben serued fully and wilt haue hym to wake, take vynegre and salt and wasche wel his temples and the thonewonges [cheek-bones] and he schal wake anon-ryght." *

The Black Bryony is one of the comparatively few monocotyledons having a blade to the leaf with "netted" veins, resembling that of a dicotyledonous leaf (Fig. 8). As the embryo of this plant has the rudiment of a second cotyledon, the blade may be a retention of an ancestral character; for the monocotyledons have, as a great group, undoubtedly descended from aquatic dicotyledons.

The flower has its parts in "threes," as prevails in the class to which it belongs. It must not, therefore, be thought to belong to the same genus as the preceding; for while the true Bryony is *Bryonia dioica,* the Black Bryony is *Tamus communis.* Nor does it climb like the Bryony, for it has no tendrils, but is a stem-climber like the convolvulus, honeysuckle, and many others.

With regard to the flowers, the Black Bryony has a tubular green "perianth" of six parts, *i.e.* three to each of two whorls; but, as they are all alike, they are not distinguished as calyx and corolla, the stamens and pistils being in separate flowers. It bears scarlet berries,

* From my transcript of *Medical Werkes of the Fourteenthe Centvrye,* p. 90.

like the Bryony ; but its glossy leaves and ternary arrangement of the flowers make it quite distinct. As observed above, it is a member of the class *Monocotyledons*, which usually have narrow (*e.g.* grass) or broad (*e.g.* tulips) leaves with " parallel " veins " running from base to tip. A small section, to which the above belongs, have net-veined or " reticulated " leaves, as is usual in *Dicotyledons*. As a rule, they betray their origin by their internal, anatomical details, both of stem and leaf.

Another plant with netted-veined leaves, but a monocotyledon, may be met with in our woodland rambles. It is a little herb with usually four oval leaves in a whorl, a terminal green flower and a black berry. It is called the herb Paris (*Paris quadrifolia*).

The Honeysuckle with its somewhat woody stem is our nearest approach in form to the tropical twiners called " lianes." The flowers grow in dense clusters or heads, having long, tubular corollas, with one petal split off from the other four, giving it a falsely irregular appearance. The ovary is inferior, the calyx, as is usual with crowded flowers, reduced to little points. The five stamens are attached to the corolla. Both they and the style are " exserted," *i.e.* standing out beyond the opening so that while the long proboscis of the hawk-moth—its legitimate visitor—penetrates to the base of the tube it gets dusted on the body.

In the autumn, as the weather becomes colder, the corollas often remain green and not coloured, a sort of " atavism " or reversion to the primitive type of flowers which was undoubtedly green, *i.e.* before insects ever came for pollen and subsequently for honey.

The Woody Nightshade (*Solanum Dulcamara*), also called Bitter-sweet, is easily recognized by its purple flowers with rather large, yellow anthers coherent into a column ; it has oval, scarlet berries. It is more of a scrambler, but can readily climb up a support. The structure of the stem at once begins to show the usual

degeneracy of climbers, as soon as the terminal part of it has found a support. More pith and less wood is formed wherever a shoot has not to support itself. This result has been mentioned as also occurring in the stem of the ivy when climbing up a wall as compared with the self-supporting and free-flowering shoots of the upper part.

"Use and disuse" are thus seen to prevail in plants as in animals with similar results.

An exceedingly common scrambler over hedges is the "cleavers" or "goose-grass" (*Galium aparine* (Fig. 9)). It belongs to the Madder family, of which genus we have a species (*Rubia peregrina*) akin to the foreign one, which yields the crimson dye (*R. tinctoria*). They have, both the Bedstraws (*Galium*) and the Madders (*Rubia*), their leaves in whorls on an angular stem. They bear clusters of twin berry-like little fruits. These, like the stem of the cleavers, are covered with little hooks so that they can catch into the wool of sheep and so can get dispersed; while the hooks on the stem enable it to climb.

The word *Galium* is Latin, from the Greek *gala*, milk, as one species, the Ladies' Bedstraw, mentioned below, as growing in poor pastures, etc., is used for curdling milk.

The rambler will observe, on examining the flower, that the ovary is inferior, that the calyx is wanting (at the top), but the corolla has four petals, and that the stamens are also four, both whorls springing from the *top* of the ovary, *i.e.* really from the receptacular tube, which is adherent to the ovary.

In the case of the Galiums, etc., they look as if they possessed whorls of six leaves. In reality, each whorl consists of only *two* real leaves, one of which may usually be recognised, by having a bud or shoot arising from its *axil;* the other four are stipules, two belonging to each leaf.

I will take this opportunity of explaining what stipules are. If sections are cut in a stem of a *Galium* to discover how the vascular bundles of a leaf-stalk arise out of the

axial cylinder of the stem, one, the largest, bundle issues from the stem-cylinder, and passing outwards through the *cortex* enters the leaf-stalk or *petiole*. Then two more of these woody bundles issue at some little distance, and travelling round within the cortex they pass up the sides of the middle one in the petiole. More than these may pass in other kinds of plants if the petiole requires greater strength ; so there may be one, three, five or more.

This process *never* applies to stipules ; they, too, have *mid-ribs* just like the leaves (indicated by the line running from base to tip) ; but they arise in all stipules, from *branches* of the lateral vascular bundles which enter the leaf-stalk. Indeed, we might regard the pair of stipules as two extra leaflets of a compound leaf ; only in the latter the basal pair of leaflets branch off in *the air*. Whereas, the vascular cords of the stipules branch off *beneath the surface of the stem*.*

Cleavers is also called Goose-grass as furnishing food for geese, the fruit being collected for that purpose. It is said that they have been roasted as a substitute for coffee in Sweden. This is interesting, as the coffee tree belongs to the same family.

Let us now examine the more woody inhabitants of a hedge, made, we will suppose, as usual, of " quick-set."

As birds occasionally drop berries when sitting on a hedge, as of elder, holly, privet, etc., the seeds germinate, and soon produce larger leaves than those of the quick-set. They accordingly make stronger roots, and so deprive their neighbours of water and light. The result is that the quick-set perishes and the new-comer takes its place, and may grow into a very large bush or tree ; similarly, if an ash tree happens to be growing somewhere near, the fruits, commonly called " keys," get wafted by the wind, and, falling into the hedge, the seeds germinate, and grow

* If the student will make a thin section, cutting the stem of a *Galium* just above and below the node, say of the cleavers, then a pocket lens will reveal the above features if it be held up to the light.

up into saplings and finally into trees. Maples have fruit also in the form of keys but in twins, while that of the ash are single. Maples are common intruders in hedges.

The Olive family is represented in our hedges by two wild plants, the privet and the ash ; and in our gardens by the lilac and the jasmine.

The leaves are always opposite and simple, *i.e.* of one blade only, in the privet and lilac, but compound in the ash and jasmine. The usual number of parts of the whorls of the flowers is four for the calyx and corolla, and two for the stamens and carpels. The fruits are of various kinds. In the olive it is a stone-fruit, in the lilac a bursting, dry capsule, in the privet a black berry, and in the ash a " key " or dry-winged fruit.

Our English ash is peculiar in having no calyx or corolla, but stamens only, or pistil only, or else both together.

A foreign species resembles ours, but it is provided with both calyx and corolla, and is called the flowering ash. It yields a sweet, sugary substance called manna, and grows in Italy.

The Elder tree (*Sambucus nigra*) or bush must be familiar to all, with its compound leaves and large flattish masses of small, creamy white, strong-smelling flowers. These are followed by small black berries, long used for making elder-berry wine ; while the flowers are required for elder-water.

The word " elder " comes from the Anglo-Saxon word " æld " ; hence the tree was called Hyldor and Hyllantree in the fourteenth century. Æld meant " fire," the hollow stems having been used for blowing up a fire.

Another species (*S. Ebulus* (Fig. 10)) is less frequently in hedges, but inclines to waste places. It is known as the dwarf Elder or Danewort ; but the origin of the latter name is obscure. The flowers have a pinkish tinge, and the berries are red. They are deleterious, and have

been fraudulently used for colouring wine. It has been used medicinally, but is too dangerous.

The Barberry is a bush not uncommon in hedgerows, easily recognised by its racemes of small golden flowers and oblong scarlet fruit in the autumn. It has triple spines, just above them a cluster of leaves and the flowering shoot.

FIG. 10.—Danewort.

The spines are really abortive leaves, out of the axils of which the shoot, with an arrested stem, arises. It often happens if the weather be very warm and much moisture in the soil from rain, just when the Barberry makes its shoots in spring, that leaves with a spiny margin grow in place of the spines, proving their real foliar nature. These leaves have also been induced to form by artificially supplying a bush with an abundance of water. The flowers are peculiar in the whorls being in threes, instead of the usual fives. Each flower consists of three little external scale-like pieces, yellow tipped with red; they are the outermost sepals; then follow three more, forming the inner whorl of the calyx. Within there are six genuine petals, the whole twelve being yellow.

At the base of each petal are two parallel, yellow oblong glands secreting honey; between these lie the filaments of the stamens, which are at first spread out upon the petals. The anthers are peculiar, for they do not split down the whole length; they open like little doors, but upwards and hinged at the top. This little valve or flap curls upwards, liberating the pollen. In the middle is the pistil of one carpel with a circular stigma.

The stamens are curiously irritable. When an insect alights in the middle of the flower, it cannot help touching the filament with its head when searching for honey accumulated at the bottom. The stamen at once rises up and strikes the insect with the anthers, dusting it with pollen, which is, of course, conveyed to the stigma of the next flower visited. The flowers would thus be crossed, but " when a hive-bee places its forelegs upon the flower, it usually causes the greater number of the stamens to close in upon the pistil " (H. Müller). There is another little peculiarity which that great observer, Hermann Müller, saw. He says, " The anther-lid carries with it almost all the pollen, and after rising to its full height, it turns that side which bears the pollen inwards towards the middle of the flower. If the stamens are now touched at their bases and made to move inwards, the masses of pollen are not on a level with the stigma, but stand above it, so that even those parts of the masses of pollen which do not touch the insect, *excluding some little scattered particles,* do not come in contact with the stigma." The words I have italicised indicate a sufficiency, for as there is only one seed, a *single grain of pollen* is all that is required to fall upon the stigma.

The above author adds : " If insect-visits fail, then as the flowers wither, the masses of pollen come of themselves into contact with the stigma."

This is a common phenomenon ; the floral organs often assume self-pollinating positions after being open to receive insects first.

It was thought by farmers in the middle of the last century that the Barberry blighted wheat if it grew near the hedge. Botanists then ridiculed the idea ; but in a sense the farmers were right ! What they observed was that if a Barberry bush grew, say, at the corner of a wheatfield, the leaves of the wheat became " rusty," *i.e.* they were streaked with a red colour when close to the bush ; and that this " red rust " extended

steadily across the field till the whole was rusted. The interpretation was at that time unknown. A fungus attacks the leaves of the Barberry, making orange-coloured spots. It throws off minute spores which do attack the wheat. These develop parasitic threads within the leaf, from which arise the red rust-spores, subsequently dark brown or black spores, consisting of two cells, called wheat mildew, appear. After a time these throw off red, one-celled spores which attack the Barberry; and so a cycle is completed. Though it was *not* really the bush which blighted the wheat, the latter suffered through its agency as the primary host plant.

Several kinds of trees occur at intervals in hedges, some abound in one county, others elsewhere, according to the soil, etc. Thus Elms are large in Warwickshire in loam or marl, *i.e.* clay or lime and sand, but Oaks prevail on the sandstone region of Kenilworth. Beeches like a chalk soil, while Poplars and Willows prefer a wet one. Certain peculiarities of growth may be noticed. Thus, for example, if Elm trees occur in a hedge composed of "quick-set," *i.e.* hawthorn, it may be often observed that within a dozen yards or so from the trees the hedge becomes "all Elm," so to say, on either side. Why is this?

The Elm, like the Poplar, as well as the Raspberry, sends off numerous suckers from the *roots*. These rise up erect and develop into leafy bushes, which more or less completely obliterate the original quickset hedge, for some yards on either side of the tree.

If the Elm trees happen to stand on the edge of a high bank formed by the road being in a cutting, the exposed roots sometimes get welded together into a shield-like mass, affording greater strength to support the trunks above.

The roots of Elms are very weak, because they are so full of large vessels for carrying water, that a cut slice looks very like a sieve. As a consequence, where

the trees are growing in clay, in intensely hot weather, the clay cracks and literally tears the root across with it. The tree may, and sometimes does, fall to the ground in the stillest, but *hottest* weather.

Another method of self-support should be noticed whenever possible. The tree being as above growing on the top of the slope which is level with the adjoining field, sends roots *horizontally* into the field, but *vertically* on the open side. The former when issuing externally at the sides of the tree curve backwards and grow into the field. The latter may be called prop- or stilt-roots. They are common in sandy soils, as at Bournemouth. The fully grown pines there, when the soil is removed to make a cutting, reveal both the horizontal primary roots and the prop, vertical, or secondary roots, which become exposed in the sides of the cutting. Thus both kinds of roots afford sufficient stability in the incoherent soil.

The common Elm (*Ulmus campestris*) is probably not indigenous; it bears deeply-notched winged fruits which never develop ripe seeds. The Wych Elm (*U. montanus*) is the usual wild elm of Scotland. It is one of the "incomplete" group of plants having a calyx, no corolla, but several stamens and pistil. It flowers *before* the leaves come out in early spring.

Other trees we shall consider in our woodland rambles. Let us now briefly examine the ditches. Several interesting aquatic plants live in them. Thus, more than one species of Buttercup is to be found either in or close to the water. The commonest in ditches is the so-called celery-leaved Buttercup (*Ranunculus sceleratus* (Fig. 11)). It grows to three or four feet high, with smooth, somewhat divided leaves, with small yellow flowers bearing oval clusters of carpels (achenes) when ripe. Though it is the tallest of our species, close to the great pyramid of Egypt, on a piece of ground annually flooded for a short time, is a small variety perpetuating itself, but only about two inches in height!

The Latin name *sceleratus* refers to its poisonous properties (from *scelus,* "crime"). It was once thought to have medicinal virtues, but it has been discarded by modern practitioners. It has apparently been sometimes eaten in mistake for celery, which is another ditch-loving plant, easily detected by well-known scent, especially on bruising it; this used to be called Smallage in the Middle Ages. As it is naturally acrid and poisonous, it is always blanched when cultivated, so that its

FIG. 11.—Celery-leaved Buttercup.

FIG. 12.—Cowbane.

deleterious properties are not developed. It grows wild in Malta, and the natives use the green shoots, but never blanch it, in soups for flavouring, but the heat doubtless dissipates the acridity.

The following is a fourteenth-century recipe containing celery and other plants herein mentioned: "A goud letuarie a-zen [against] alle yuellis [evils]; for ye rotelyng in ye yrote, for boillis, for sorys in ye side, for ze stomake—Nyme [take] horshouue groundesueli [groundsel], ysope, sentorye [centaury], ache [celery], vinel [fennel]

Dead-Nettle.

solsequie [?] piliole [pennyroyale], and nepte [bryony], of alle y-liche moche, and do pepur and honey and sethe hit togedre and drynke yer-of at morwe and at eue."

Some members of the "Umbellifers"* are found in ditches, such as the Cowbane (*Cicuta virosa* (Fig. 12)). There are three species of Water Dropworts, such as the Hemlock Water Dropwort (*Œnanthe crocata* (Fig. 13)); but the true Hemlock (*Conium maculatum* (Fig. 14)),

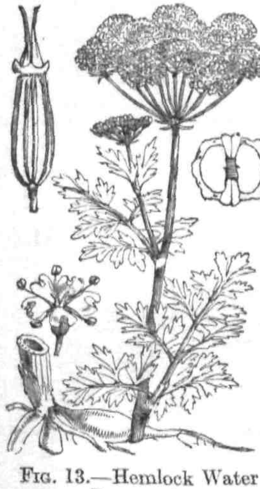


FIG. 13.—Hemlock Water Dropwort.

FIG. 14.—Hemlock.

though often occurring by roadsides near ditches, is not a true water plant. This deadly poisonous plant is recognizable by its tall *smooth* and distinctly *spotted* stem. It has much divided leaves, like the others mentioned.

Fig. 13 illustrates an important fact, that the primary or tap-root of all *aquatic* Dicotyledons is arrested through

* So called, because the flowers on stalks all radiating from one point is called an "umbel."

the deteriorating effect of water upon germination (see Fig. 44). The result is, that as the stem grows and increases in height it acquires the form of an inverted cone, *i.e.* on its point. Moreover, all the roots must now arise out of the joints or nodes of the stem. Those in Fig. 13 are swollen and called tuberous roots, which store up water and food materials.

The Great Willow-herb, or Codlins and Cream, as

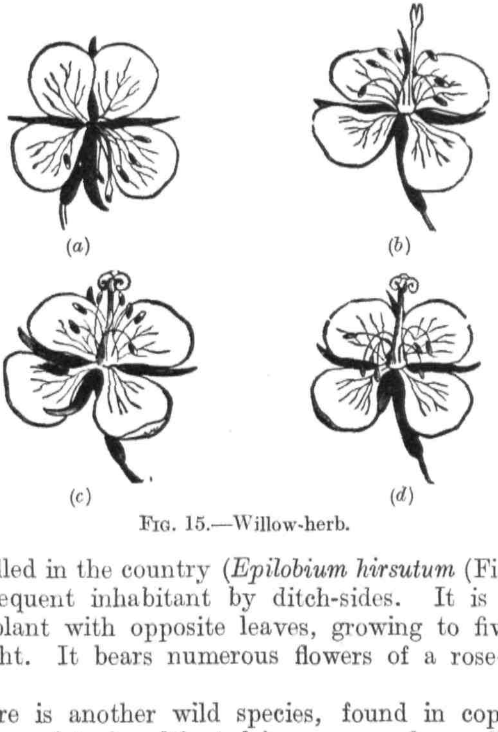


FIG. 15.—Willow-herb.

it is called in the country (*Epilobium hirsutum* (Fig. 15)), is a frequent inhabitant by ditch-sides. It is a tall, hairy plant with opposite leaves, growing to five feet in height. It bears numerous flowers of a rose-purple colour.

There is another wild species, found in copses, of which a variety is cultivated in many gardens called the Rose-bay or French Willow. It has long "racemes" of rose-purple flowers, but is a quite smooth plant. The

slender lance-shape of the leaves has suggested the name as resembling willow leaves. As there is an important difference in the process of fertilisation, we will consider the flowers of the latter species (*E. angustifolium*). The following is H. Müller's observations : "The bright crimson flowers are very conspicuous, growing on a stalk a foot long. The honey is secreted by the green, fleshy, upper surface of the inferior ovary, and is easily accessible to insects and yet well sheltered from rain. The expanded lower end of the filaments form a hollow cone, which incloses the base of the style and the surrounding honey. Where the style issues at the apex of this cone, hairs upon the style prevent the entrance of raindrops, while insects easily gain access between the filaments.

"In young flowers, the anthers of the stamens, covered with pollen, project forwards as an alighting-place for insects, together with the style, which is still short and bent downwards with its four stigmas folded together (Fig. 15, *a*). Alighting, sucking, and pollen-collecting are thus all made easy, and cross-fertilisation in case of insect-visiting is insured, and self-fertilisation is rendered impossible."

Subsequently the style rises up (represented in (*a*) by a club-like extremity in front). The four stigmas then separate (as in *d*), and are ready to receive pollen from a flower previously visited as in (*a*).

Now let us turn to our British species (*E. hirsutum*). Self-pollination is quite possible, for the stigmas mature simultaneously with the anthers (*b* and *c*). Without excluding the possibility of cross-fertilisation, the stigmas curl backwards and come in contact with the pollen of the longer stamens as shown in (*c*), (*b*) being the preliminary stage where neither are the anthers quite ready nor the stigmas unfolded.

We have ten species altogether. *E. palustre*, as the name implies, is also to be found in ditches, bogs,

etc. While two are Alpine; such is *E. alpinum*, found at 4000 feet elevation in Scotland. Like so many high mountainous species, it is a dwarf, from three to nine inches in height. Another species, *E. montanum*, we shall find in our ramble through a village, for it is frequent on the tops of walls (Pl. III.).

All of these have long, inferior ovaries, and when the flower falls from the top and the numerous seeds ripen, four valves split from below upwards, and the seeds have now developed a crest of silky hairs, which begin to spread out (just as the pappus does in a dandelion or thistle), and so the seeds thrust one another out of the pod. The wind then carries them away like parachutes.

Two species of Speedwell (*Veronica* (Pl. III.)): the Brook-lime (*V. Beccabunga*, a name coined from the German "Bachbunge," a "brook-bunch") has oval leaves and small bright blue or pink flowers, like the familiar sky-blue Germander Speedwell (*V. Chamædrys*), which will be referred to in another ramble. The other is *V. Anagallis*, which has longer and pointed leaves with small pale-lilac or white flowers. In both species the flowers form elongated racemes. The four-petalled corolla and only two stamens are very unusual in flowers. The former species was used as a drug-plant in the Middle Ages, being supposed to be good for the gout, etc.

One of our seven species of mint is not uncommon by ditches, river-sides, and marshy places. It grows from one to three feet high, has opposite, softly hairy leaves, and short, stout spikes, with compacted lilac or purplish flowers. It is *M. aquatica*. The generic name is *Mentha*.

A variety is called Bergamot Mint. It has an odour of peppermint. Indeed, the latter plant (*M. piperita*) is regarded as a cultivated form of the water-mint. It is said to be nowhere indigenous. Menthol is obtained from a species of mint growing in Japan.

Another species called Penny-royal (*M. Pulegium*) frequents wet places, but not usually ditches. It was

formerly used medicinally and also for culinary purposes, for which it was called "Pudding Grass," "Grass" being like "wort," a word simply meaning "herb." The present name seems to be a corruption of "Piliole-rial" of the Middle Ages.

One species, the corn-mint, is a cornfield weed (Pl. XIV.).

The common Rush, growing in great tufts, is still used for rush-lights. It has a smooth cylindrical stem with a strong skin. If this is peeled off, a very narrow strip being left to prevent its breaking, and the pith dipped repeatedly in melted tallow, such forms the wick of the rush-light candle. As the wick is the soft pith, made up of united star-shaped cells, it leaves no unburned end, as a cotton-wick used to do, and snuffers were required. When lighted they stood on the floors as a night-light in a tin cylinder about a foot high, perforated with round holes, well remembered by the writer when a child.

The useful Watercress is a common inhabitant of ditches, streams, etc. It is too familiar to be described, were it not for the fact that some deleterious plants have been taken for it. It bears leaves with three to six pairs of leaflets, the end one being the largest. The flowers have the usual characters of "crucifers," * viz. four sepals, four petals, six stamens, and a pistil with pods longer than the flower-stalks. It is a most wholesome salad plant.

Of the Horse-tails (*Equisetum*), of which we have eight species, one-half are land-plants, the other aquatic. The largest species (*E. maxima*) grows to six feet in height. They are not flowering plants. They possess rough, fluted stems and branches, having only a ring of leaves reduced to toothed sheaths round the nodes. This species frequents bogs, ditches, etc.

The family consists of one genus only. It is usually the case that, when one or very few plants represent a

* So called, as the flowers have their petals like a Maltese cross.

whole family, such are the last representatives in the world of a probably large family of plants that lived in ancient times, even when coal-plants flourished. Such is the case with the Horsetails. Remains of many genera allied to them lived then, and the oldest known is more like the existing horsetail in some respects than the later ones.

The structure of the stems and position of the roots, the former being conical at the base, while the latter come out of the nodes, just like modern monocotyledons, proves that such were aquatic then, as the one mentioned is now.

RAMBLE III

Through Pasture-land

We will now leave the main-road and investigate the adjoining meadow. It is not perfectly flat, but sloping down to the river below. The lowest level is, as usual, moister than the higher ground; consequently various plants have selected different sites for their permanent abodes. Of course, grass is the main feature in every meadow which produces hay, and there are various species. Many have no special English names. Let us consider a few. There is the sweet Vernal grass (*Anthoxanthum odoratum*), one which, to a considerable extent, gives its sweet scent to new-mown hay. The Fox-tail (*Alopecurus*) and the Cat's-tail (*Phleum*) grasses are two genera, having their flowers in cylindrical "spikes," which renders them easily distinguishable. The hairy *Holcus* is recognizable by the very soft and almost woolly character of the leaves. It often grows in woods as well. The Quaking-grass will be at once known by its round "spikelets" on slender stalks, making a spreading "panicle" or cluster.

The "meadow" (*Pca*) and "fescue" (*Festuca*) grasses will be abundant, but they require a more minute inspection than can be here given. The rye-grass (*Lolium*) and the wheat-like genus (*Triticum*) are, however, easily recognized by their two-ranked, close-fitting spikelets on the main stalk; for while the rye-grass has them fixed edgewise, the wheat-genus has them attached broadside. They may be awned like barley and oats, or not. The difference is

that the rib of the main chaff-scale to each "floret" is prolonged or not. The Darnel (Fig. 46) is a species of rye-grass, but it occurs on arable land or cornfields.

The stems of grasses have interesting features which must be noticed. From rapid growth they become hollow straws; but to give strength to them, they are provided with solid diaphragms at intervals or nodes.*

The vascular woody bundles run vertically up the hard tissue of the cylinder, between the nodes, called internodes. They appear as numerous dots seen in a cross-section. If the wind bent and tried to break an internode, the force must be resisted by a *downward pull* against the upward and lateral tension produced by the wind. The source of the downward pull resides in the cylinder and in the powerful diaphragm. Just as one feels the resistance when breaking a stick across the knees, so the plant tries to resist the tendency to break it. The diaphragm is more or less cup-shaped or conical. This supplies the common fulcrum at the bottom of the cup for a good proportion of the pulling force of the strain, in addition to all the cords in the stem which pull downwards in opposition to the strain.†

The orchid family is often represented in meadows. It contains the most curious plants in the world; and it will require some care to describe the flower of an orchid so as to make it clear to a beginner. The aid of Darwin's ‡ figures of the purple orchis (*O. mascula* (Fig. 16)) will perhaps enable one to do so. The flower has three sepals and three petals, all removed, except one petal, called the lip (A, B, C). Now, notice how the inferior ovary is twisted (A); there is no stalk, nor style; but the perianth and the single anther (B, *a*) stand on the summit of the ovary. This, of course, means that the ovary (of three carpels)

* The rambler should examine a piece of a straw, by making a vertical cutting through a node.

† This interpretation was submitted to an engineer, and he pronounced it to be perfectly correct and scientific.

‡ Fig. 16 is taken from Darwin's *Fertilisation of Orchids*.

5

Spotted Arum.

PLATE VI. Opp. p. 59.

is invested by a receptacular tube, which has carried the perianth to the top.

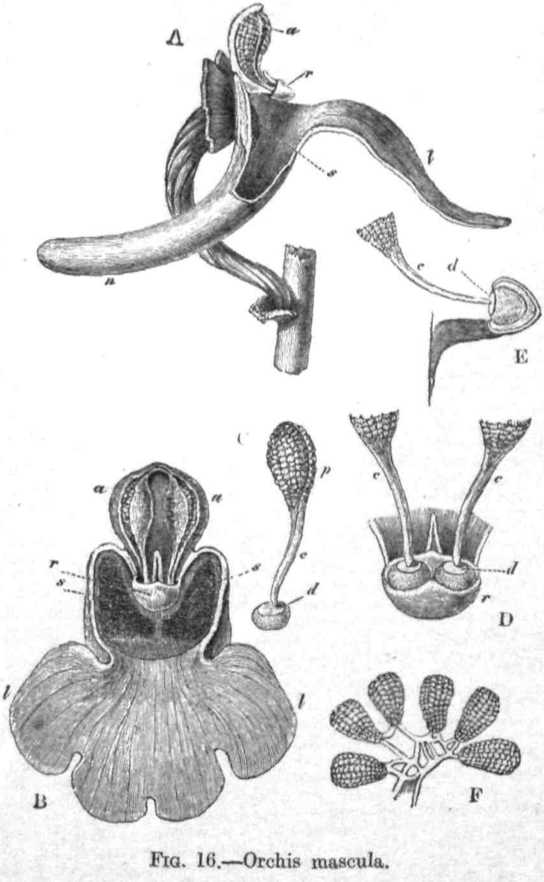


FIG. 16.—Orchis mascula.

The lip carries a tube closed at the end or spur (A, *n*); though no honey has been detected in it.

Let us now cut off all the three sepals and two of the petals, leaving the lip, as is represented in A and B. A bee having alighted upon the lip, or *labellum*, as it is called, can thrust its tongue down the hole into the spur. Through a pocket lens, the two dark patches at the sides above the lip (A, B, *s*) are the two stigmas. As there is no style they form the summit of the ovary. They are slimy and sticky. The third stigma is curiously changed for a totally distinct use. There is a pouch overhanging the spur, with a "little beak," called the *rostellum* (A, B, *r*); this has no known special function, the importance lies within the pouch.* It is a closed bag; but if a slight touch be made by pressing the front of it *downwards* with a pencil-point the upper surface ruptures in two circles and exposes to view two masses of gum, upon which stand the circular feet of the "pollen-masses."

D represents the bag depressed in front, *d* the circular disks on the balls of gum, *c* is a single pollen-mass (*p*) with its stalk or caudicle, and the viscid disk or foot (*d*). The club-like end above is made of collections of pollen-grains united together by a network of highly elastic threads, as shown in F. These coalesce to make the caudicle (*c*).

E is a vertical section of the rostellum, (*v*) showing the above details, as in a side view. These are (*d*) the disk or foot of the pollinium, (*c*) being the caudicle.

The two pollen-masses, one in each anther-cell, clearly show that there is only one stamen. This is the rule in orchids; but in our rare Lady's Slipper (*Cypripedium*), an orchid found in Yorkshire, there are two.

If the reader has followed me thus far, we will now see what it all means. When an insect alights on the lip and is busy putting its proboscis or tongue down the spur, its head is brought into contact with the front of the pouch. It naturally presses downwards. This ruptures it and exposes the circular feet of the pollen-masses (as in D). These being covered with gum, one or two, usually both,

* Darwin calls this the "rostellum."

the feet stick to the insect; and on withdrawing its head, it pulls them out of the anther-cells and they stand erect upon its head (C).

If that were all, on visiting another flower the pollen would *not* hit the stigma down below, beneath the rostellum (*r*), just above the orifice to the spur (B).

To find out how the pollen-masses come to be *horizontal* and not *vertical*, so as to be almost parallel with the proboscis, the following experiment must be made. Pass a pencil point downwards into the spur, press it lightly in so doing against the pouch; let it rest for a few seconds, then withdraw it gently, and the two pollen masses will be caught standing erect but slightly inclined, one toward each side. After about half a minute the gummy matter sets hard, so that if the club-ends be seized they can be drawn out half an inch or more, like stretched india-rubber, rather than break away when sticking to the pencil.

Now watch them. As the gum dries up the two caudicles *bend forward* near their bases, until they stand nearly parallel with the pencil. The reader will understand, that if it be again thrust gently into a flower, while the point enters the spur, the pollen-masses will strike the two stigmatic surfaces (B, *s*), respectively.

It is a very simple experiment which will explain the process better than words, and show how all the above elaborate contrivances conspire to secure cross-fertilisation. For without the aid of humble-bees, etc., the pollen-masses cannot possibly be removed from the anther-cells and be applied to the stigmatic surfaces.

Though the insects probe the spurs, it is a remarkable fact that they do not always secrete honey into them. Darwin investigated this fact, and describes his observations as follows:—

"In examining the nectaries of *O. Morio* and *O. maculata*, and especially *O. pyramidalis*, I was surprised at the degree to which the inner and outer membranes forming

the spur were separated from each other—also at the delicate nature of the inner membrane, which could be most easily penetrated—and, lastly, at the quantity of fluid contained between these two membranes. So copious is this fluid (having first merely cut off the ends of the nectaries of *O. pyramidalis*), by gently squeezing them on glass under the microscope such large drops of fluid exuded from the cut ends that I concluded that the nectaries certainly did not contain nectar; but when I carefully made, without any pressure, a slit along the upper surface, and looked into the tube, I found that the inner surface was quite dry.

"I then examined the nectaries of *Gymnadenia conopsea*, and of *Habenaria bifolia*, which are always one-third or two-thirds full of nectar; the inner membrane presented the same structure in being covered with papillæ, but there was a plain difference in the inner and outer surfaces, being closely united, instead of being, as with the above-named species of orchid, in some degree separated from each other and charged with fluid. Hence I am led to suspect that moths penetrate the lax inner membrane of the nectaries of these orchids and suck the copious fluid between the two membranes." *

Another plant, although occurring from the north to the south of England, is somewhat "local," namely, the Meadow Saffron or Autumn Crocus (*Colchicum autumnale*), but it does not belong to the same family as the *Crocus* and *Iris*, though the pink or white flowers look just like those of the crocus in form. Moreover, the leaves are large and broad, and are not formed simultaneously with the flowers, which appear in the autumn, but only in the following spring, when the large capsule makes its appearance. It contains numerous brown seeds.

The plant has a large "corm" or solid stem used in medicine, but the whole plant is poisonous.

It was probably the Rose of Sharon and the Lily of

* *Fertilisation of Orchids*, p. 49.

the Valley of Scripture.* The Hebrew word means "acrid bulb."

The Dyer's Greenweed (*Genista tinctoria* (Pl. VIII.)) is rather local. It is a woody plant with yellow pea-like flowers. Its name is derived from the fact that a yellow dye was obtained from it. It is one of the flowers of the pea-family which explodes when a bee visits it. The flower is shown *before* an insect visitor has come in (Fig. 17, *a*). When a bee alights on the keel and wing petals, which are locked together at the base (see *b*), the flower bursts open (*b*), by the bending of the "claws" or little stalks of the united keel petals (*c*).

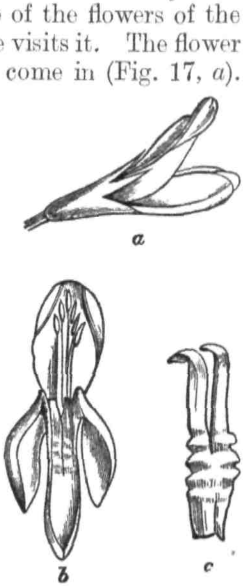


FIG. 17.—Dyer's Greenweed.

The Lucerne (*Medicago sativa*), cultivated especially on chalky soils, as about Ramsgate, also explodes as soon as anything, such as a pencil point, is thrust down to the base of the keel, all the petals fly open, and the staminal tube curls upwards.

One of our handsomest wild flowers is the Meadow Geranium (*G. pratense*, Pl. IX.). We have many species but mostly with smaller flowers, as the Herb Robert. It grows to four feet in height, with seven- to nine-lobed roundish leaves, and bears many large purple flowers. These have their whorls in fives, but there are two whorls of stamens, making ten. (1) and (2) show the back and front view of a stamen. The pistil has five carpels, with long coherent styles. When ripe, each carpel separates from below upwards, and as it is elastic, on so doing, the ovary at the base bursts, and its one seed is jerked to a distance.

Being very conspicuous, the flowers are abundantly

* See my *Plants of the Bible* (Bagster).

visited by bees and other insects. It appears to have quite lost the power of self-fertilisation retained by the smaller-flowered species of Geranium. In fact, a perfect gradation occurs between this species and the very small-flowered *G. pusillum*, which can readily fertilise itself.

The wild Geraniums or Crane's-bill must not be confounded with the Stork's-bill (*Erodium*) nor with the so-called garden Geraniums, for these last are species and hybrids of Pelargoniums from the Cape of Good Hope.

In *Erodium* the dried "beak" (style) of each carpel becomes spirally twisted and retains the seed within the ovary. When it falls to the ground and becomes damp it untwists, and by means of hairs which hold on to any object as a fulcrum, it elongates and buries the seed. The oat behaves in a similar manner.

Two species of buttercup are common in meadows, the "bulbous" (*R. bulbosus*) selecting the highest and driest ground, while the "field" buttercup (Fig. 1) prefers the damper soil. If the meadow has retained the old form of "ridge and furrow," then the former is confined to the ridges down to a foot from the bottom of the furrow, while *R. acris* is only seen in the furrows.

The bulbous Ranunculus sometimes grows in damp peaty soils. It then completely changes its appearance. It varies much in size, but has no "corm"; it is very smooth, and produces offshoots from the base of the stem. It also is in blossom in late summer and autumn. This variety is not common; but it is very abundant in a field close to Poole Harbour.

If a meadow happens to have rather a poor soil, plants may be present which would be better away if good fodder grass be wanted. Three such interlopers are the Lady's bedstraw (*Galium verum*), the Milfoil (*Achillea millefolium*), and the Ox-eye daisy (*Chrysanthemum leucanthemum*). The first is at once detected by its slender four-angled stem, whorls of leaves and stipules, with tiny, but numerous four-petalled yellow flowers. The name is derived from its

former use for bedding, even for ladies of rank. The Latin name *Galium* is from the Greek *gala*, milk, as the plant has the peculiar property of coagulating milk, like rennet, and is still used in making cheese.

The Ox-eye daisy is a troublesome perennial and difficult to pull up, but should be eradicated, as well as the Milfoil or Yarrow, which should not be allowed to get a hold upon the soil, as it creeps with an underground stem.

We have two species of this composite genus *Achillea:* the Yarrow or Milfoil (*A. millefolium*) and the Sneezewort (*A. Ptarmica*); the former is the commoner, but both are troublesome invaders on account of their extensively creeping, underground stems. They have much divided leaves, hence the term Milfoil. They have small white heads in dense clusters, but the ray florets of the Sneezewort are rather larger than those of the other species. The colour varies from white to pink or even purple.

Their medicinal uses of the Middle Ages are now discarded as of no value.

The Sneezewort was used like snuff to make one sneeze, but there was probably no principle in it like nicotine, but only a mechanical irritation being the result of taking the powder.

Clovers or trefoils (*Trifolium*) are common in meadows, though different kinds are cultivated in fields by themselves. The common purple clover (*T. pratense*) and the smaller Dutch clover with white flowers (*T. repens*) are pretty sure to be in the meadow. Indeed, the latter will doubtless be found in our roadside rambles; for it is extremely common among the short grass, which it readily exterminates.

The clovers all form excellent fodder. The rambler should notice which kind of bee habitually visits these two clovers. He will notice that as a rule the humble-bee goes to the red clover and the hive-bee to the white, but the former often bites a hole at the bottom of the flower to save trouble, of which the hive-bee takes advantage!

The small Hop trefoil (*T. procumbens*) with small, globular yellow-flowered heads is often abundant.

An interesting little kind of clover (*Trifolium subterraneum* (Fig. 18)), so called because it buries its pods in the soil, occurs on pastures of a poor soil, "from Chester southwards," as at Bournemouth; the heads of flowers do not exceed $\frac{1}{4}$ inch in diameter. The corolla is cream-coloured, and is probably self-fertilising or cleistogamous. Mr. Darwin examined the flower and its peculiarities, and the following account is abridged from his description.

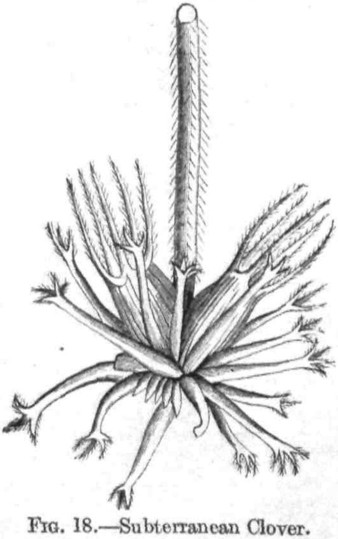


FIG. 18.—Subterranean Clover.

"The flower-heads of this plant produce only three or four perfect flowers. All the other flowers are abortive and modified into rigid points. After a time five long elastic claws, which represent the divisions of the calyx, are developed on their summits. As soon as the perfect flowers wither they then bend downwards (see Fig. 18) as the main flower-stalk or "peduncle" stands erect, and closely surround its upper part. The imperfect flowers, which are the central ones in the flower-heads, ultimately follow, one after another, the same course. Whilst the perfect flowers are bending, the whole peduncle curves downwards, increasing in length until the flower-head reaches the ground. Nineteen upright flower-heads, arising from branches in all sorts of positions were marked, and after twenty-four hours six of them were vertically depressed, having travelled

Bryony.

through 180°. Ten were extended horizontally, and these had passed through about 90°. Three very young peduncles had as yet only moved a little downwards.

"When the flower-heads reach the ground, the younger, imperfect flowers in the centre are pressed together in the form of a cone, whereas the perfect and the outer imperfect flowers are reflexed and closely surround the footstalk.

"Thus the form they assume is adopted to offer as little resistance as possible in penetrating the soil. The flower-heads are able to bury themselves in garden mould or sand. The depth to which they penetrate, measured from the surface to the base of the head, is from a quarter to half an inch. With plants in the house a head partly buried itself in six hours. After three days only the tips of the reflexed calices were visible. In six days the whole had disappeared. Plants growing out of doors are believed to bury their flower-heads in a much shorter time. Only a few of the flower-heads, which from their position are not able to reach the ground, yield seeds, whereas the buried ones never failed to produce as many seeds as there had been perfect flowers."

Darwin then alluded to the "circumnutation" which, under the circumstances, became a "rocking" motion, described as follows :—

"It is unnecessary to enter into all the details of observations on the movement of the footstalk, from the time it begins to bend until the flower-head is buried in the ground. Suffice it to say, that throughout this period oscillation was going on. A peduncle was watched during fifty-one hours, whilst in the act of burying itself in a heap of sand. When buried so that the tips of the sepals alone were visible, it was rotating (circumnutating). When the flower-head had completely disappeared beneath the sand it was still rotating. Any one who will observe this process will be convinced that the rocking movement due to the circumnutation of the stalk, bears an important part in the act. Considering that the flower-heads are very

light, that the peduncles are long, thin, and flexible, and that they arise from flexible branches, it is incredible that an object, as blunt as one of these flower-heads, could penetrate the ground by means of the growing force of the peduncle, unless it were aided by the rocking movement. After a flower-head has penetrated the ground to a small depth, another and efficient agency comes into play. The central and aborted flowers, each terminating in five long claws (*i.e.* the tips of the sepals), curve towards the peduncle, and in so doing can hardly fail to drag the head down to a greater depth, aided as this action is by the circumnutating movement, which continues after the flower-head has completely buried itself. The aborted flowers thus act something like the hands of a mole, which force the earth backwards and the body forwards." *

The Daffodil (*Narcissus Pseudo-narcissus*) occurs in fields and copses. It is a true native, but has long been cultivated, so in some cases it may be an "escape." Similarly the two-flowered narcissus, with pale yellow or white flowers, is generally an escape, but "is thought to be truly indigenous to Ireland and some parts of western and southern England." †

This sentence will apply to some other plants, not spreading over England generally. They are to be found in the Channel Islands and Normandy; and are, in fact, a fragment of the south European or Mediterranean flora, indicating a former union between England, Ireland and Europe. Several of these will be referred to in the rambles especially suitable for meeting with them.

This little group of south European plants is believed to have originally spread to south-west Ireland and south-west England when there was land communication between Ireland and Spain; while Cornwall, Dorset and Hampshire were continuous with France and Belgium.

This is indicated by two very local plants, besides

* Darwin's *Movements of Plants*, p. 513, ff.
† Bentham's *Handbook of the British Flora*.

others, which may be mentioned here. One is the rose-coloured Gladiolus, common in the fields of Malta, and a large kind of Lords and Ladies, which is also abundant at the roadsides of that island. It has a very offensive odour. The central "appendix" to the "spadix" is always yellowish, and not purple as in our British species, with spotted leaves (*Arum maculatum*).

The Gladiolus only occurs in the New Forest and the Isle of Wight; while *Arum italicum* is found locally from Cornwall to Sussex.

The Primrose (*Primula vulgaris* (Pl. X.)) and the Cowslip (*P. veris*) are abundant, though the latter frequents open meadows and the former the banks, etc. There is a peculiarity about the stamens and pistil which must be noticed. Most species of this genus have two kinds of flowers, but they are never found together on the same plant. Plate X., 1, 3 shows one of each kind, in which the stamens have their anthers at the top of the tube of the corolla, in (1) with a short style and low down, in (2) with a long style; so that an insect visiting (1) gets its proboscis dusted at one spot which conveys the powder to the stigma of (2), and *vice versâ*. Darwin found that when this "legitimate" crossing, as he called it, was tried experimentally, more seed was secured than otherwise.

The pistil is peculiar in having what is called a "free central placenta" (2, 4), *i.e.* a column bearing ovules in the middle of the ovary quite free from the sides.

The common Mallow (*Malva sylvestris*), with rather large purple flowers, is a conspicuous plant and grows in many localities, as waste places, roadsides, etc.; but the rosy Musk Mallow (*M. moschata* (Pl. XI.)) frequents pasture-land; while the low-lying Dwarf Mallow (*M. rotundifolia*) is another roadside and waste-ground plant. It has much smaller and paler-coloured flowers. It is self-fertilising, while the others are insect-visited. They are all remarkable for the column of many coherent stamens standing erect in the middle of the flower.

The Marsh Mallow (*Althæa officinalis*) is a different genus, found in wet meadows near the sea, as near Felixstowe. All malvaceous plants have a peculiar mucilaginous juice which renders the last-mentioned useful for lozenges known as guimauve, as well as demulcent drinks. The flower of the mallows being generally very conspicuous, we may be quite sure its structure is well adapted for insects. First, we shall find the honey between the bases of the petals protected by a tiny *chevaux de frise* of stiff hairs. The stamens have their anthers clustering and erect at first, concealing the immature styles and stigmas. The free ends of the filaments now bend outwards, so the one-celled anthers hang down. The bee, crawling about, gets well dusted with pollen on the back.

The stigmas next rise up and spread outwards like a terminal purple brush, which sweeps the pollen off the bee's back, brought from a previous flower. As the stigmas are quite unprepared for pollen while this is mature, self-pollination is prevented.

It is not so with the dwarf, round-leaved species, with paler and smaller flowers. When these open the stigmas are mature simultaneously with the pollen, and being very long they twist about thrusting all their tips among the anthers ; so that it is quite independent of bees, etc., although they do come for honey.

The structure of the mallow flower is easy to understand by dissecting it. First observe the " palmate " leaf, but more or less cut into lobes, much more so in the " musk," than in the purple mallow; the colour is usually called " mauve," this being French for mallow. At the base of the leaf-stalk are two appendages or *stipules ;* they usually act as protectors of the bud in the *axil* of the leaf.

It will be remembered that every part of the flower of a buttercup is separate or free. The mallow shows us how they can be " coherent " ; for the five sepals are united together, carrying three bracts behind them. The

corolla, however, has its petals free, but "adherent" to the "coherent" filaments, which form a tube, with the tips free, bearing one-celled anthers.

Similarly the many carpels cohere together, while the stigmas only are free.

Valerian or All-heal (*Valeriana officinalis*) occurs in wet meadows, banks of streams, copses, etc. It grows to some three feet in height, has pinnate leaves like those of the ash, and terminal clusters of pale pink flowers. The calyx is on the top of the adherent receptacular tube investing the ovary, and grows into a feathery pappus to convey the seed-like fruit away. There are only three stamens in the little tubular corolla.

The root is bitter and acrid with a fetid odour which attracts cats. As soon as they recognise the plant they roll upon it, and it is with difficulty that they can be driven from it.

The spikenard of the ancients is now known to be a member of the Valerian family. It was held in great estimation by the ancients, being used at baths and feasts as a favourite perfume. It obtained a high value among the Romans, so much so that the contents of a small box made of precious stone was considered an equivalent for a large vessel of wine, and a proper contribution for a guest to make to an entertainment, according to the ancient custom; and as an evidence of which, we have the complaint of Judas. When the woman anointed our Lord, "the alabaster box of ointment, very precious, might have been sold for three hundred pence and given to the poor."

The smell of spikenard to modern taste is far from pleasant, but the ladies of Nepaul (for the plant grows beyond the Ganges, thus accounting for its high price at Rome) use it as a perfume for the hair.

The syllable "spike" refers to the bristly stem, being covered with the remains of old leaves, these resembling ears of barley with their awns; while *nard* means "scent."

A common plant of the Crucifer family in moist meadows is the Cuckoo-flower or Lady's Smock (*Cardamine pratensis*). The leaves lie on the ground, but the flowering stem rises to some nine inches, bearing four-petalled rosy flowers. It sometimes has a curious way of multiplying the plant independently of seed; for the leaves lying on the moist ground "strike root" and then form buds. As the leaf decays away a new plant arises.

Certain foreign ferns often grown in conservatories may be seen bearing numerous little fern-plants on their fronds. Each one can propagate the plant, as soon as it reaches the ground. We shall see that grasses often do the same thing in mountainous regions. The process is called "Vegetative multiplication," as distinct from the reproductive process proper by seed.

Two or three parasites upon grass roots are not uncommon in meadows, the Yellow Rattle (*Rhinanthus Cristagalli*, Pl. XII.) and the Red *Bartsia* (*B. Odontites*). We shall refer to the first when we ramble across a cornfield, but both might be described here. They belong to the Fox-glove or Snapdragon family, but while the former has small tubular, yellow flowers, those of the Bartsia are of a dull pink. Their peculiarity is that when their roots come in contact with those of the grass, they adhere to and penetrate them, deriving nourishment from the "host." Consequently the grass will be seen to be short and "starved" wherever these parasites abound. The Bartsia is commoner perhaps in the grass of roadsides, while the Yellow Rattle is more frequently in fields.

Having green leaves like the mistletoe, they are not completely parasitic, as they can nourish themselves like ordinary plants.

The little Eye-bright (*Euphrasia officinalis*) is closely akin to the preceding, and equally common. It is an annual growing to about ten inches high, with white or lilac corolla and veined with purple, one-half inch in length, with the central lobe of the lip yellow. It is

suspected to be parasitic like the preceding. It stands next to them in our Floras.

The name Eye-bright arose from the supposed virtue of the juice of the plant for disorders of the eyes, probably from some suggestion at the brightness of the corolla to the eye, as the rule of "signatures" was the one physicians of the Middle Ages went by.

Another plant of the same group occurs in the moister parts of fields known as *Pedicularis palustris*, while its ally, *P. sylvatica*, is found in copses. The corolla is of much the same shape, the colour being of a dull pink.

RAMBLE IV

Across and Around a Cornfield

Let us now try to know all we can of the wild flowers in a cornfield, by keeping to the path which crosses it, and by making our way by the hedge around it. We shall discover quite a different set of plants from those in the meadow. While the latter were perennials, in a cornfield, which is ploughed up every year, they are mostly annuals.

Thus we found four kinds of perennial buttercups, but the one growing among the corn (*R. arvensis*) is an annual. It will be easily known by its much divided leaves and small yellow flowers, though similar in structure to others ; but it has prickly achenes.

Some half-dozen cornfield weeds have been introduced and "improved" as florists say, by cultivation in the garden, by varying the colours, etc. Thus the blue Larkspur (*Delphinium Ajacis*) is naturalised in Cambridgeshire. The flower consists of a blue calyx, with only two blue petals. The sepal is prolonged into a pointed tube as a "spur," or "nectary," because it holds the honey secreted by two prolongations of the petals which lie within it. It has many stamens, which turn their anthers upwards, so that a bee alighting upon them gets dusted with pollen below. The three carpels project their stigmas just so as to receive the pollen brought from another flower. The flowers vary in colour—especially under cultivation—from blue to pink or white.

Fig. 32.
Dyer's Greenweed, Woad-waxen.
(*Genista tinctoria*).

Plate viii., p. 75

The scarlet-flowered Pheasant's eye (*Adonis autumnalis*) or its ally (*A. æstivalis*), an earlier flowering annual, is cultivated. They have finely divided or feathery foliage and scarlet flowers with a dark basal spot. In Malta there is a yellow variety called *citrina*. It is probably a return to the ancestral yellow.

The scarlet poppy (*Papaver Rhœas*) is now cultivated since the Rev. W. Wilks, Rector of Shirley, near Croydon, raised the numerous kinds of "Shirley Poppies," a variety with a white rim to the petals which accidentally appeared in his garden. "This one flower I marked," he tells us, "and saved the seed of it alone. Next year, out of about 200 plants, I had four or five on which *all the flowers* were white-edged. The best of these were marked and the seed saved, and so on for several years, the flowers all the while getting a larger infusion of white to tone down the red, until they arrived at quite a pale pink and one plant had absolutely pure white petals. I then set myself to change the black central portions of the flowers, *i.e.* the *anthers, stigmatic surface and pollen from black to yellow* or white, and succeeded at last in obtaining a strain with petals varying from the brightest scarlet to pure white, with all the shades of pink between them, and with all possible varieties of flakes and edged flowers, and having golden or white stamens, anthers, stigmatic surface and pollen and a white base to each petal."

Such is the history of the world-wide Shirley poppies, an excellent example of the variability of plants.

The structure of the flower of the poppy is very simple, but peculiar in a few points. There are only two sepals, which fall off as the bud opens and the petals, crumpled up in the bud, expand and smooth themselves out. The pistil consists of several carpels coherent into the so-called poppy-head. There is no style, but the stigmas form rays on the top of the ovary. On cutting this across vertical plates are seen running up to the ray-like stigmas and not meeting in the middle; otherwise the ovary is hollow

and not divided into distinct cells, as occurs in so many plants. These plates are outgrowths from the margins of the coherent carpels and their use is to extend the surface for bearing seeds.

Poppies are full of a milky juice, which is poisonous, and supplies opium. The opium poppy is a cultivated form of a species growing wild in fields of South Europe (*Papaver setigerum*). I have found it in Malta. It closely resembles the former, so frequently grown in our own gardens. All the poppies have a white, milky juice which is extracted by slashing the unripe poppy heads. As it coagulates it is scooped off and constitutes crude opium.

A number of varieties of the plant called by botanists *Brassica campestris*, are recorded as occurring as weeds of cultivated fields. It is the genus which contains the cabbage tribe (*B. oleracea*), the mustards (*B. nigra* and *B. alba*), and the troublesome charlock (*B. Sinapis*) which so often makes a field look perfectly yellow.

The species mentioned above contains the rape, and colza, the turnip, the navew, and the swede ; but botanists are not altogether at one in distinguishing them.

As cultivated plants the rape and colza, grown for the sake of the oil from the seed, has a spindle-shaped root, while the turnip varieties are globular. Pliny tells us that in his day the Greeks had discovered a way of turning the rape into the turnip, by growing it in a very stiff soil. The meaning of this is, that the soil prevents the root descending and so it swells laterally. Naturally it is a cord-like, long root, similar to those figured of the carrot, parsnip, and radish.

The white mustard (*B. alba*), the one grown in gardens with cress, which is not indigenous, is itself considered as an introduced plant by some botanists. It differs from the black mustard (*B. nigra*) in having a long flat " beak " at the end of the pod, whereas the black mustard has a very short round one. Moreover, the white has

fewer seeds, with a spreading fruit-stalk and not great as in the black mustard, which is a native only near the sea as mentioned in our seaside ramble.

A small herb allied to the scrambling cleaver, called Field-Madder (*Sherardia arvensis*), is common. It is only a few inches in height, as it is inclined to be prostrate. It has the usual whorl of leaves and stipules, the corolla being lilac in colour, but only $\frac{1}{8}$ inch across. It was named after Mr. James Sherard, an eminent botanist.

The Penny-cress (*Thlaspi arvense*) is an annual herb growing from one to two feet in height, with small white four-petalled flowers and remarkably shaped pods for a cruciferous plant, being nearly round, broadly winged, flat, and hence the popular name.

Another crucifer, the Candy-tuft (*Iberis amara*), is more familiar as an old-fashioned garden plant, with white or purple flowers. It occurs in cornfields, but as a wild plant it has rather insignificant blossoms. It grows in the centre (*e.g.* near Hitchin) and east of England.

As the flowers are rather massed together as a raceme,* they are visited by insects from the front. In accordance with the usual result, the corollas have become irregular, the outermost petals being larger, thus forming a landing-place for the insect visitors.

A similar irregularity occurs in the outer flowers of umbelliferous plants, as the sheep's parsley and hogweed, etc., and for the same reason.

The Catchfly (genus, *Silene*) has eight British species, one, the bladder campion, is easily recognized by its inflated, nearly globular and dark-brown calyx, mentioned with its maritime variety in the seaside ramble ; but two species not quite so common may be here referred to, *S. Otites*, which grows to three feet in height, and has sticky glandular leaves, hence the English name ; it is found

* A *raceme* is the name for the "inflorescence" or cluster of flowers, each of which has its own stalk or *pedicel*, all springing from a main stem or *peduncle*, *e.g.* a bunch of currants.

more especially in the eastern counties. It has rather small flowers of a pale yellow-green colour, the petals not being cleft as in the preceding.

The other is *S. noctiflora*, the night-flowering kind, a softly hairy plant, having a few flowers only, with cleft petals, of a rosy white colour. It is remarkable for spreading out the corolla at dusk, when it is very fragrant. At first only the stamens are matured; but when daylight comes the petals roll up as if withered; but they expand again at eventide, and the stigmas are now mature and ready to receive the pollen, brought by moths at night.

We have three species of Gromwell (*Lithospermum*), one of which is a cornfield weed (*L. arvense*). The name is due to the fact that the ripe "nutlets" (for it belongs to the Borage family, which, like the Labiates, have a two-celled ovary, but breaking up into four nutlets) are stony, having a white polished appearance. When broken and touched with acid, the inner part fizzes, implying the presence of carbonate of lime, but the outer coat does not, indicating the presence of silica. The plant does not exceed at most a foot and a half, and like the Borage and other members, is very rough. The corolla is funnel-shaped, about half an inch across, of a cream-white colour.

A small yellow-flowered variety of the pansy is common in cornfields. It differs from the larger kind with purple and yellow flowers, in being self-fertile. The Figure (19) will explain the difference.

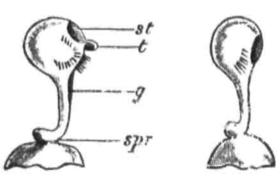


FIG. 19.—Pansy.

With regard to the Pansy and Violet, the posterior petal having become the lowermost, is prolonged into a spur, closed at the end. Two of the five stamens, immediately over the spur, are provided with honey-secreting appendages, which lie within the spur which collects the honey. The

five anthers form a hollow cone round the ovary. When an insect alights on the lower petal, it is guided to the orifice of the honey-bearing spur by means of streaks of colour, which are called "path-finders." There is one also on the style (Fig. 19, *a, g*). It passes its proboscis down the tube, forcing the anthers asunder in its passage. It thus gets dusted with pollen. On entering another flower, the globular stigma (*a, st*), which projects beyond the anthers (forming a sort of mouth with an extended tongue (*a, t*)), now receives the pollen. In order to insure this, the style is bent just above the ovary, and thus forms a spring (*a, spr*), which tends to keep the stigma down upon the front petal, so that the tongue-like stigma (*t*) cannot fail to scrape off the pollen from the proboscis when forced under it.

The stigma, moreover, has two fringes, one on either side, like whiskers, and these keep the pollen back just at the entrance of the spur, so that none can reach the stigma in front. Consequently the ordinary large-flowered pansy is unable to fertilise itself, and fails to set seed unless visited.

In the small-flowered cornfield variety (*b*) all these hindrances to self-pollination are wanting, so that it is quite independent of insects and consequently sets an abundance of seed.

The garden pansies or Heartsease were at first the cultivated varieties of the common wild pansy, found in many places, such as waste ground in gardens, or in fields. The flowers are purple and yellow in colour. By sowing the seed in a rich garden soil, the colours varied and the flowers became larger and much more handsome. When, however, some foreign sorts were introduced, and crossed, still better kinds were obtained; and these are the varieties we now know as the present-day garden pansies. The size is enormous compared with the wild ones; and, moreover, instead of being irregular in shape, that is to say, the petals of different

sizes, the modern form is as nearly circular as it is likely to be.

A sub-species of the wild pansy (*Viola lutea*) with blue-purple or yellow flowers is found in hilly districts in the northern half of England.

The Coriander (*Coriandrum sativum* (Fig. 20)) Hooker now includes as an established wild flower in south and east of England, but it was originally a cultivated plant. Like so many members of the umbellifer family, the leaves are finely divided, but the fruit, instead of being *long*, is *globular*, hence the expression used of the manna, "round like coriander seed." Strictly it is the *fruit*, not *seed*, just as we wrongly speak of caraway seed, another umbellifer.

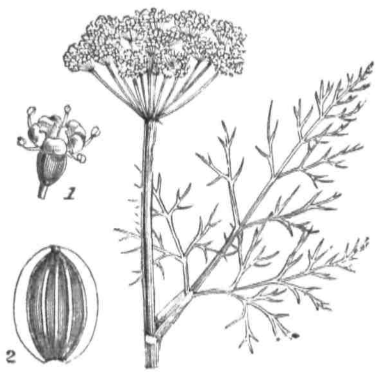


FIG. 20.—Coriander.
[No. 2 should be circular.]

It has been cultivated in England for its fruit, this being used in confectionery. It has an aromatic oil, to which its useful properties are due. It is included in our pharmacopœia as a carminative and for its stimulating properties. Fig. 20 shows both flowering and fruiting umbels, with their short, globular fruits and finely dissected leaves.

Another plant allied to the *Linaria*, already alluded to, is the Yellow Rattle (*Rhinanthus crista-galli*, Pl. XII.). In this the mouth of the corolla gapes. The characteristic feature is the enlarged bladder-like calyx. The plant is a parasite attaching its roots to those of the corn and other grasses. If it invades a meadow at all plentifully, the grass soon deteriorates. When it attaches itself to corn it often grows very tall, and is then called the variety *major*.

One more parasite of the same group is the Cow-wheat (*Melampyrum arvense* (Fig. 21)). This is found in cornfields, while another species occurs among grass

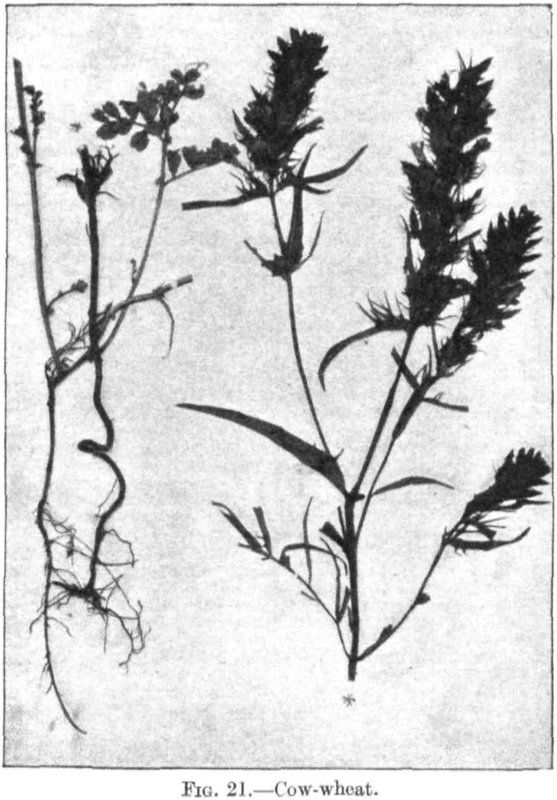


FIG. 21.—Cow-wheat.

(*M. pratense*). The first is a very local plant, occurring in East Anglia and the Isle of Wight. The second is commoner. It has a yellow corolla with a long tube; whereas *M. arvense* is rosy with a yellow throat. The

figure shows the parasitic habit by adherence to grasses, etc.

The Corncockle (*Githago segetum* (Pl. XIII.)) grows from one to two feet high, and bears purple flowers, They are solitary with very long leaf-like sepals.

The Shepherd's Needle (*Scandix Pecten-Veneris*) has much dissected leaves and white flowers. The fruit is prolonged into a kind of beak, by which it

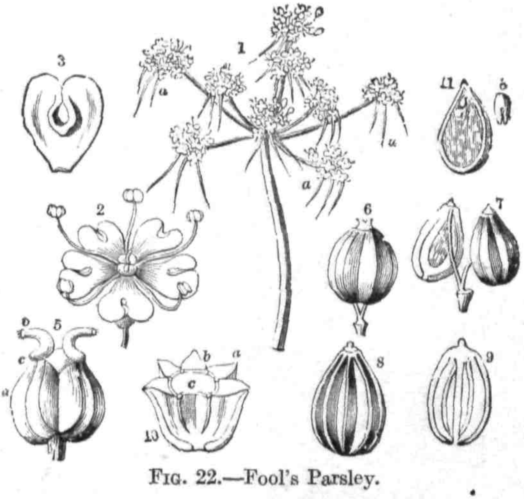


FIG. 22.—Fool's Parsley.

may be easily identified. The Fool's Parsley (*Æthusa Cynapium* (Fig. 22)) somewhat resembles the preceding, but has no "beak." The pendulous bracts below the flowers are the distinguishing feature of the latter. We will take the Fool's Parsley as an example to describe the flower and fruit of umbellifers generally, as they all have fundamentally the same structure.

The main stalk of the "*Inflorescence*" (1), *i.e.* the group of flowers all taken collectively, carries a whorl of primary "umbels," like the stays of an umbrella. Then these

Meadow Geranium.

may carry a second umbel, each of which, called a *pedicel*, bears a flower (2). Such is called a *compound umbel.* If there were only one whorl, it would be a *simple umbel.* In the illustration it is compound, but the flowers are so close together that the secondary stalks are not seen. This plant can be easily known, as stated, by the pendulous, pointed bracts (1, *a*).

With regard to the flower, there appears to be no calyx, while the five white petals stand on the top of the ovary; just between the petals five little points represent the sepals, but they may have vanished. It usually happens that when flowers are much crowded together the calyx tends to disappear, as we shall see in the composites, etc.

The position of the corolla on the top of the ovary is explained by the latter being adherent to the receptacular tube, which has carried the sepals, petals, and stamens to the summit, just as in the rose, but the tube in that flower is not adherent to the numerous carpels. The inrolled tips of the petals (2) guide an insect's proboscis to the honey. This is secreted by two cushion-like outgrowths (5, *c*) from the top of the ovary (5, *a*), from the inner margins of which the two styles (5, *b*) arise.* There are two carpels (*b*) indicated by the two short styles, so that fruit consists of two halves which separate (7); each half is supported on a branch of a forked support (7).† (8) is an entire fruit miscalled "seed" in the case of the caraway. On cutting one of the two across, five corky ridges are seen and a single seed (*c*). No embryo is seen in (10) because the white endosperm has been cut through below it. It is very small at the upper end (11, *a*). (9) is the inner side of one half of the fruit.

* It is not well drawn in (5); but it is more correct in (2).

† This is formed out of the margins of the carpels which are united in the middle. The "beak" in Geranium, described above, is of the same nature.

A curious little plant of the buttercup family, called the Mouse-tail (*Myosurus minimus*), is found in cornfields from Northumberland to Scotland. It has a little honey-spur to each of the five sepals. The petals are very small, sometimes wanting; and the stamens—a rare exception in this family—only five in number; but the numerous carpels form a densely packed spike, which suggested the English name.

The Cleavers (*Galium Aparine*) has been described as a tall plant scrambling over hedges. A small ally (*G. tricorne*) is not uncommon in cornfields, but chiefly on a chalky soil. It has the appearance of the cleavers, but the fruiting flower-stalks are recurved with remarkably large granulated fruits.

The Yellow Vetchling (*Lathyrus Aphaca* (Fig. 23)) is occasionally found in cornfields, but it is commoner in south Europe. It is remarkable for being almost entirely without leaflets, for (excepting the seedlings) the tendril represents the main stalk of the leaf, and in compensation the stipules are enlarged in order to do duty for leaf-blades. They are triangular or spear-head in shape.

FIG. 23.—Yellow Vetchling.

The genus *Lathyrus* has some poisonous species, including the present one. People have suffered from violent headaches after having eaten the seeds. Cases have occurred when the seeds of the foreign species (*L. sativus*) have been mixed with the field pea, in consequence of which many horses have died.

Darwin has recorded a few observations on the climbing power of *L. Aphaca*. He writes as follows:

"This plant is destitute of leaves, except during a very early stage, these being replaced by tendrils, and the leaves themselves by large stipules. It might, therefore, have been expected that the tendrils would have been highly organised, but this is not so. They are moderately long, thin, and unbranched, with their tips slightly curved. Whilst young, they are sensitive on all sides, but chiefly on the concave side of the extremity. They have no spontaneous revolving power, but are at first inclined upwards at an angle of about 45°, then move into a horizontal position, and ultimately bend downwards. The young internodes, on the other hand, revolve in ellipses, and carry with them the tendrils. Two ellipses were completed, each in nearly five hours; their longer axes were directed at about an angle of 45° to the axis of the previously made ellipse."

Two or three members of the Labiate family are casual weeds in cornfields. Such are the Hemp-nettles (*Galeopsis Ladanum* and *G. Tetrahit*). They bear many-flowered whorls, rather dense, with leafy bracts. The corolla has the usual lipped form, as in the Dead-nettle. The first species is softly hairy with red corollas, not exceeding about eighteen inches in height. The second named is a taller plant, sometimes two or three feet in height, with roughish foliage, and bearing yellow and purple flowers. It is, therefore, a much more conspicuous plant than the preceding.

A variety with a larger corolla, from one to one and a quarter inch broad, is occasionally met with.

The Corn-mint is alluded to below (p. 90). The figure of the Dead-nettle on Pl. V. will give a fair idea of a Labiate plant, with the characteristic four-angled stem, opposite leaves and clusters of axillary * flowers giving the *appearance* of true whorls, but there are no flowers *between* the leaves, that is, on the internodes.

One small annual, the Henbit Dead-nettle (*Lamium*

* The angle between the leaf-stalk and the stem is called the "axil."

amplexicaule (Fig. 24)) is a very common weed in waste, sandy places as well as fields. The small leaves are rounded, with the margins indented. The corolla is small, with the hood closed down over the lip (Fig. 24). This is really the bud stage, but it never advanced or opened. The curved style is bent down so as to place the two stigmas among the four anthers; hence it is entirely self-fertilising and cleistogamous, *i.e.* "concealed unions."

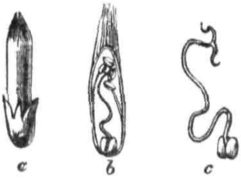


FIG. 24.—Henbit Dead-nettle.

It is a good example of the wide distribution of self-fertilising weeds; for Hooker gives its localities as Europe, North Africa, North and West Asia, North-west India, and introduced into America.

Of cornfield Composites, there is the familiar Cornflower or Blue-bottle (*Centaurea Cyanus*) so much cultivated as a garden plant, where it has varied in colour from blue to pink and white. It will be noticed that in this flower the ray-florets have corollas with a trumpet-like mouth, much larger than the corolla of the ox-eye daisy, for example. This enlargement has caused the non-development of the stamens and pistil, so that such ray-flowers are "neuter" and are unable to set seed; but they render the head more conspicuous. The corolla of the disk-florets is regular, with a five-toothed border. Below the corolla is the ovary which carries it on the top. The calyx is represented by rough hairs.

Fig. 25 will explain the structure of the stamens. There are five; the filaments arise from the corolla tube, the five long anthers are coherent round the style as a rod within them, the two stigmas (*b*) are pressed together at first. The anthers are provided with triangular flaps at the top, which are closed then, making a cone (*a*). This cone bursts open (*b*) as the style elongates and brushes out the pollen by means of hairs under the

stigmas (*b*). It is not till then that the two stigmas separate as in (*b*). The honey is secreted in a little cup at the base of the style (*a*). The arrow shows how the insect's proboscis is able to reach it.

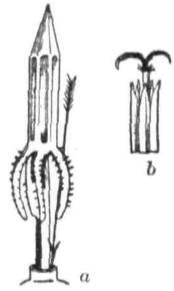


FIG. 25.—Stamens of Centaurea.

Dr. H. Müller observed all the insects which visited Composites of all sorts near Lippstadt in Germany. He records no less than 546 species of insects in the following average proportions: *Lepidoptera* (Butterflies and Moths), 15 per cent.; *Apidæ* (Bees, etc.), 41 per cent.; *Diptera* (Flies, etc.), 27 per cent.; other short-tongued insects, 17 per cent. Bees, therefore, proved to be the chief visitors.

The Composites, then, well illustrate the fact that corolla tubes are proportionate in length to the highly-specialised insects, a universal feature seen in all other families as well. The enormous number of species and wide diffusion of the Composites are proofs of the advantages accruing to it from the peculiar structure of the flowers.

The Corn-Marigold is another Composite which has been introduced in the gardens. The Latin name is *Chrysanthemum segetum*, and therefore an ally of the familiar Chinese and Japanese autumn-flowering kind. It represents another type, for the ray florets, though tubular below, have a flattened limb spreading outwards. As the ray florets were always originally the same as the disk, the change of form is effected by reducing the five-petalled corolla to three; and the loss of the stamens, so that the ray florets of this section are always female only. In the Cornflower the ray corolla is so greatly enlarged that nature could not even perfect the pistil! So, as already stated, they are called "neuter."

There are two other genera of the same group of the composites as the last, each with two cornfield species.

They are called *Matricaria* and *Anthemis*. They have finely divided leaves and daisy-like heads with yellow disk florets and white ray florets. *M. chamomilla* is the wild chamomile, abundant, not only in the borders of arable fields, but in all waste places, as around farms, brickfields, etc. It is strongly scented, whereas *M. inodora* is scentless, otherwise it is very like the preceding. *Anthemis arvensis* is the corn Chamomile and *A. Cotula* the stinking Mayweed. All have an "involucre" of bracts.

A third species, *A. nobilis,* is the true medicinal chamomile, but it is a maritime plant, generally found on the grassy parts. But it also occurs on inland places.

A simple distinction separates these two genera. The "general receptacle" or top of the flower-stalk which bears all the florets is quite naked in *Matricaria,* but covered with chaffy scales in *Anthemis.*

The medicinal chamomile flowers are from the cultivated "double" kind. That is to say, the heads are *all* like the ray, the disk, tubular, and yellow florets have been converted into white ones, like the ray. It is not so strongly scented as the wild form.

A similar change has taken place in other cultivated Composites, as Dahlias, Asters, Chrysanthemums, etc., of our gardens.

Other Composites, as thistles and some species of *Centaurea,* as the Hardheads, differ from all the preceding in having *all* the florets tubular with no disk florets.

There is one species of *Centaurea* known as the Caltrap (*C. Calcitrapa*). It is the plant translated "thistle" in the Bible. It is a common weed in Palestine as well as in the deserts. The radiating spines of the bracts round the head have suggested the name "star-thistle." It must be understood that it has nothing to do with true thistles, which belong to different genera. The true Caltrap was a metal ball with four spikes, so that in whatever way it falls there is always one spike upwards.

They were used in warfare to impede horses. *Calcitrapa*, the Latin specific name, means "heel-trap."

The Sowthistle (*Sonchus arvensis*) is also a cornfield Composite; but like the dandelion, *all* the florets are alike. They have strap-shaped corolla-tubes, but the petals are *not* reduced in number, so five little points can be counted at their ends. They all have both stamens and pistil.

The Teasel family stands next to the Composites in our floras. It resembles the latter in the members having their flowers or florets in heads, with or without a distinction between ray and disk-florets. We have only two genera, the Teasel (*Dipsacus*) and the Scabious (*Scabiosa*). The only one found about the borders of cornfields is the Field Scabious (*S. arvensis*). It grows from two to five feet in height. The heads are from one to one and a half inch across, pale lilac in colour. The other two species of scabious occur in pastures. A fundamental difference between the Teasel family and Composites is the freedom of the stamens, the anthers never being united into a cylinder as in all members of the Composite family, as explained above, so that a head of florets is at once recognised by the filaments and anthers hanging freely out of the florets.

A little member of the *Campanula*, or Harebell family, is *Specularia hybrida*. It has no English name, but can easily be recognised by the long, almost leaf-like sepals and small, nearly flat corolla, called "rotate" or "wheel-like," by botanists. It grows to about ten inches in height. Though found sparingly elsewhere, it is chiefly to be looked for in the eastern counties.

There is a similar dwarf species of Snapdragon called *Antirrhinum Orontium*. From six to eighteen inches in height, it is a much branched annual; the corolla is less than an inch long, of a rose-purple colour, but similar in form to its larger ally, *A. majus*, introduced probably in the Middle Ages.

The Water Mint and Peppermint has been spoken of as resident in ditches, etc., but one species is a cornfield weed (*Mentha arvensis* (Pl. XIV.)). The corolla of the mints is more approaching regularity than is that of the Dead-nettle, though the structure is otherwise the same as that of other species.

The Spurges, small herbs noted for their milky juice, of which we have twelve species, have one or more as field weeds. The flowers are very peculiar. They are very small, quite green, and consist of little cups with rounded or else crescent-shaped glands. This cup is "involucral," like the involucre of the Composites mentioned above, only in one piece forming a cup. A similar involucral cup is in the French Marigold, a garden, old-fashioned Composite with yellow florets.

Within this cup is a central pistil of three coherent carpels, standing on its own stalk: that is the female flower. It is surrounded by a number of male flowers, each consisting of a single stamen on its own stalk. They do not mature all at once, but one at a time, showing they are independent flowers, though reduced to a minimum of simplicity!

Fig. 26.—Sun Spurge.

The Sun Spurge (*Euphorbia Helioscopia* (Fig. 26)) is a common annual weed.

Of cornfield grasses, there is the wild oat (*Avena fatua*). It was once thought that this species was the origin of the cultivated oat, but the great authority on the *History of Cultivated Plants*, Mr. A. de Candolle, says: * "None of the varieties of oat has been

* P. 376.

1 2 3 4

Primrose

PLATE X. Opp. p. 91.

discovered in a truly wild state. It is very probable that they have all been derived from a single prehistoric form, a native of eastern temperate Europe and of Tartary."

The oat is remarkable for having a long hairy awn or prolongation to the chaff-scale. When it dries it becomes twisted, and on falling to the ground the hairs catch in anything, as grass, which will give a "fulcrum"; the awn then becoming moist, untwists, and so buries the grain, which is concealed within the glume or chaff-scale, and is provided with a sharp point at the end, aiding it in penetrating the soil.

Wild Barleys are represented by four species, one of which (*Hordeum murinum*) is very common in waste places, easily recognized by the numerous awns from the chaff-scales. It has been called barley-grass. Its spikes of flowers are about two inches long. To understand the structure an ear of cultivated barley should be studied, wherein it will be seen that *two* rows of spiklets on opposite sides bear grains, while *four* rows of abortive spiklets lie between, hence the flattened aspect of the ear.

In certain countries on the Continent, barley is grown which produces grains in all the *six* rows. This is common in south Europe, as in Malta, where the barley is only grown for fodder and pulled up green. The reason why the two-rowed barley is only grown here is that the quality of the grain is better for making malt (Fig. 27).

A grass described in our floras of the British Isles, as being frequently wild, but really an escape and naturalised, is the canary grass (*Phalaris canariensis*), the seed of which is familiar to all who keep cage birds. It is consequently occasionally found in waste places and cornfields. It is easily recognised by its globular head or spike, the chaff-scales being winged.

It is said that in Italy the grains are ground into flour and make into cakes, etc., and also in the Canary Islands, which are the native country of this grass. The flour is also employed there in dressing silks, fine calico, and muslin.

There is another species (*P. arundinacea*), but it occurs

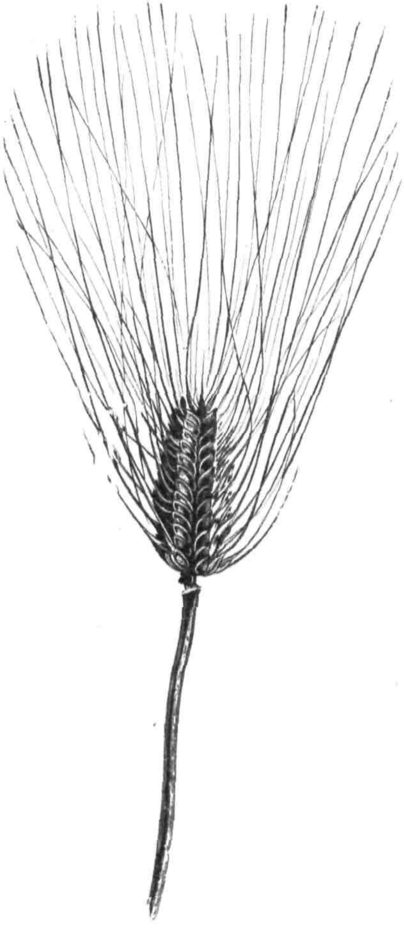


FIG. 27.—Six-rowed Barley.

on river-banks, growing from three to five feet in height.

Darnel (*Lolium temulentum* (Fig. 28)) is like a large kind of rye-grass and not uncommon. This is the plant wrongly called "Tares" in the parable. The blade is broad and might be mistaken for wheat before the ear is formed. It has been credited as being the only poisonous grass; probabilities incline to the belief that this is a mistake, though when it is attacked by a fungus called "Ergot," then it is very deleterious. Bread has been made from the pure grain and eaten with impunity. In Malta, the drivers of the carriages used for hire, often collect bunches of this grass for fodder. The Latin word *temulentum,* like "rye" from the French *ivre,* means "drunk," as the injurious effects are said to be just those of the poisonous ergot.

FIG. 28.—Darnel.

We have delayed considering the structure of the flowers of grasses, as most wild ones are rather difficult for beginners, but as we are now in a cornfield we will examine an ear of wheat when in flower, recognisable by the anthers hanging out from the spike (Pl. XV.). The ear or spike is composed of a number of little spikes or spikelets placed in notches on the stalk on opposite sides. We will pick off one of these and remove its several parts. (1 and 2) are chaff-scales or outer *glumes* at the base. *Gluma* is the Latin for a chaff-scale. Within it there are four to five distinct flowers or florets, placed on alternate sides of the little stalk which bears them. The elements of a single flower consist of a *flowering glume* (3), then follows the *pale* (4), which is more delicate, with two ridges or *keels* ending in two points. The edges of the pale are like flaps to protect the three stamens and pistil within them.

Just inside and at the base of the pale are two tiny bodies (5) called *lodicules.* They are thought to be the last relics of a lost perianth. The three anthers are attached very lightly to their slender filaments, so the pollen can be easily wafted away. On the other hand, the two stigmas are covered with hair-like projections, giving them a feathery appearance, so as to catch the pollen with ease.

A grain of wheat consists of the seed invested by the dried ovary. On cutting it open from top, where the tuft of hairs called the beard is, to the base, the greater part is composed of cellular endosperm mostly filled with white starch ; but just under the skin is a layer (bran) which contains the *most nutritious substance*, *i.e.* for building of muscle, bone, nerves, and brain, for doing which white starch is *useless,* so that the whitest flour, from which the bran has been separated, is the *least valuable* of flours. "Whole-meal," if ground *sufficiently fine*, contains everything and is most nutritious. But, as a rule, it is not fine enough, so the nourishment is partly lost.

The embryo will be found at the base of the grain, just under the skin on one side where the outer surface is wrinkled. On dissecting it out—for it lies freely in its bed of endosperm (flour), the top will be seen to be a sort of "shield," *i.e.* the cotyledon, which is wrapt round the little bud or plumule, while the lower end is the base of the stem called the radicle. As no primary or axial root will be developed, secondary, the so-called "adventitious" roots, spring out of the end of the stem. This is characteristic of all monocotyledons, as also in aquatic dicotyledons, from which they have descended.

RAMBLE V

Through a Village

Now let us suppose our road to bring us to a village, where walls have been built instead of hedges. We shall be able to study nature even on them, for the seeds of several different kinds of plants often get blown up to the top and grow there, notwithstanding the small quantity of dust or broken mortar in which their roots can penetrate. Some are, indeed, quite large plants, such as the Snapdragon, introduced from South Europe. Another is the yellow *Corydalis*, allied to the Fumitory, also from South Europe. The Wallflower is not infrequent upon old ruins, as of the Abbey at Bury St. Edmund's. This and the Clove Pink (*Dianthus Caryophyllus*) and Wild Pink (*D. plumarius*), the origin of the garden pinks, were probably cultivated by the monks of old. The Spur-Valerian (*Centranthus ruber*) and the little ivy-leaved Toad-flax (*Linaria Cymbalaria*) are often abundant in walls and rocks, both having been introduced many years ago.

Most of the wall-plants are small from starvation; but if they happen to grow in a good soil they may at once grow up into quite respectable plants, say from two to three inches to a foot or more in height. The common Thale-Cress (*Sisymbrium Thalianum*), for instance, has a little rosette of leaves and a slender flower-stem bearing small, white, four-petalled flowers, and somewhat four-angled pods, three-quarters of an inch long, spreading horizontally.

There may also be species of another crucifer called Whitlow-grass (*Draba*), all preferring walls and rocks. They have white petals, excepting one species only found on Pennard Castle, Glamorganshire, which has yellow petals.

Perhaps the commonest is the Vernal Whitlow-grass (*Erophila vulgaris*). This has the petals notched, whereas the Whitlow-grass has entire petals.

All these can pollinate themselves, as is usually the case with such crucifers. As we have not yet had any large-flowered crucifers, I will take the Wallflower as a good example, while the Shepherd's Purse (*Capsella Bursa-Pastoris*), abundant everywhere on waste ground and neglected gardens, will represent the small-flowered kinds. The first thing to notice is that the flower-stalks have no bracts at their base, an unusual condition, but characteristic of crucifers in general. The calyx has four erect, rather stiff sepals, making a sort of false tube, for they are *not* coherent. Remove them carefully, and notice that the two side sepals have honey-pouches. The four petals have very slender stems or "claws," as they are called, supported by the calyx. Then six stamens can be counted; two, the lowest, are shorter than the four inner ones. Moreover, the former arise out of honey-glands. The pistil has a long ovary, a short style, and two stigmas extending towards the front and back. When an insect alights on the top of the flower, it gets dusted with pollen below, just where the stigmas will touch it of the next visited flower. It thrusts its proboscis down the sides where the shorter stamens are, and into the honey-pouch; so that cross fertilisation is easily secured. Nevertheless, all the crucifers seem quite capable of self-fertilisation as well.

Another little plant common on walls is the "three-fingered" Saxifrage (*Saxifraga tridactyliets*), so-called because the leaf has three prominent lobes. It grows from two to six inches in height, and has a rosette of leaves,

bearing sticky glandular hairs, to which flies get fixed, but whether they can absorb nourishment from the insects is not known.

The white Stonecrop (*Sedum album*), as well as the commoner yellow-flowered (*S. acre*), has cylindrical, fleshy leaves. The former is said to be indigenous in the Malvern Hills and Somerset, but a garden escape elsewhere, being grown as rock plants.

Fleshiness of stems and leaves is a common method of water-storage among plants which grow in deserts, etc., where the supply of water is scanty. Members of the Cactus family, many of which are cultivated, have thick, fleshy stems, while sedums and others utilise their leaves for the same purpose.

When we take our seaside ramble we shall find that salt has a similar effect upon maritime plants. *Sedum anglicum*, for example, is abundant in the bank of a hedge close to Poole Harbour. It has small white flowers.

Another fleshy-leaved plant frequenting rocks and walls, but more especially on the west side of England, is the Pennywort (*Cotyledon umbilicus*). It has "peltate," *i.e.* shield-like leaves, the stalk entering the centre of a circular blade. It bears racemes of small drooping flowers of a greenish-white colour, the corolla being cylindrical. It is commoner on the western side of England, as about St. Ives, Cornwall. It has been used by Welsh people for certain complaints of the eyes, and even for epilepsy, but like the greater number of plants employed by the old herbalists, it has not apparently any really useful medicinal properties.

Several other small weeds, such as one of the Willow-herbs (*Epilobium montanum*), may often be seen. There is also a "male fern" occasionally to be found growing between the bricks, called *Ceterach*, more especially in the west counties. It is only about four to six inches in size, densely clothed with brown scales on the under side of the frond. These absorb water and act as water

reservoirs during dry periods. The "Wall-rue" fern is another small species of the same genus (*Asplenium Ruta-muraria*). The frond is only about one or two inches in length.

The House-leak (*Sempervivum*) often grows on roofs, but it is not truly indigenous. It has thick fleshy leaves growing in globular tufts or rosettes. The flowering stems may be two feet in length, bearing many flowers about one inch diameter of a dull red-purple. The number of parts in the whorls is unusual, being twelve in each. A curious feature is that there are often a whole circle of stamens, next to the pistil, more or less converted into carpels. A similar "conversion" is common in Wallflowers. When this is the case they have no petals, and gardeners pull them up as "rogues."

As the pistil, however, is well formed, being just visible at the top of the four erect sepals, I have fertilised it with pollen from red and yellow petalled Wallflowers, and raised very fine "races" of Wallflowers, all from one and the same rogue-plant. This attempt at or successful "change of sex" may occur in any plant, but some seem to be more liable than others. Thus female flowers are not infrequent on the male catkins of the edible chestnut. Similar "freaks" occur in begonias, etc., but as a rule they do not sufficiently develop the stamens and pistils to be able to set seed.

The Pellitory (*Parietaria*) may be found everywhere on old walls and dry, waste places. The structure of the flowers agrees with that of the stinging nettles, as it belongs to the same family, but it has no stings. It is a degraded flower in having only a calyx of four sepals, four stamens, and a pistil of one carpel. The stamens, as in the nettles, are peculiar in having spring-like filaments. As long as the end is closed up, the filaments curl *inwards;* but on the sepals separating they spring up and suddenly curl *outwards*. The jerk causes the pollen to be thrown into the air, away from the stigma. This is tufted so as

Fig. 63.

Silver-Weed. (*Potentilla anserina*). Crosswort. (*Galium Cruciata*). Yellow Rattle. (*Rhinanthus Crista-galli*).

Plate xii. P. 99.

to catch the pollen more easily as brought by the wind from another flower.

It was a plant used in the Middle Ages as a plaster for broken limbs, etc. The specific name, *officinalis*, indicated that it was sold as a drug plant in the shops, but most of the old drugs were found to be valueless and could not be sold, hence our expression, "like a drug on the market"! It was considered the most important thing to have harvested well all the drug-plants for the winter, and we still use the expression, as suitable or adapted to any well-prepared scheme, that it is "cut and dried." "Drug" is from Anglo-Saxon *draga*, and means "dried."

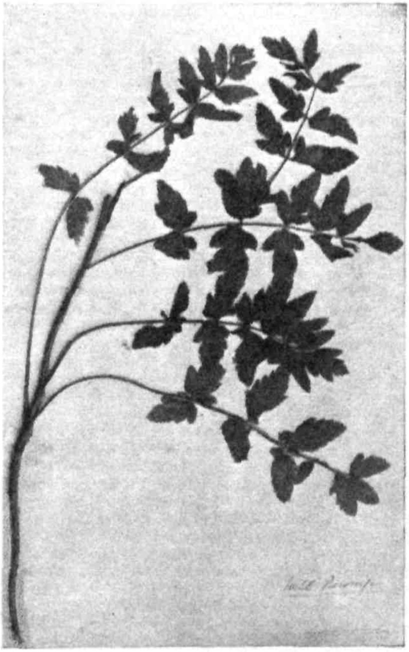


Fig. 29.—Wild Parsnip.

Let us now look over a low wall around a cottage garden, and see what British wild plants are growing in it. It is a rather untidy one, and several little weeds are conspicuous. The tufted annual grass (*Poa annua*) is in evidence around the sides, while the Wall Barley-grass (*Hordeum murinum*), with its spiky heads, forms a line under the wall. The Shepherd's Purse, with its numerous little triangular pods, abounds, having a rosette of jagged

leaves on the ground. The black *solanum* (*S. nigrum*), with drooping clusters of small white flowers and black berries, together with the dwarf stinging nettle (*Urtica urens*), is sure to be about somewhere. Groundsel, of course, the hairy Bitter-cress (*Cardamine hirsuta*), and a few more annuals are crying out for attention *to be pulled up before they seed!*

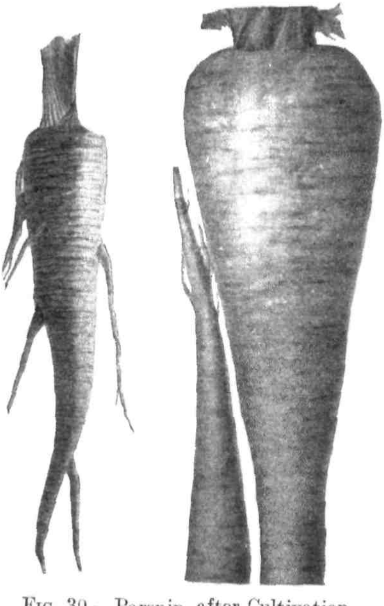


FIG. 30.—Parsnip, after Cultivation.

Of the cultivated root crops, we shall see a row of Parsnips, another of Carrots, a third of Turnips, and perhaps some Beetroot as well. Whence came they? First, the Parsnip (Fig. 30) is a field plant, common by roadsides, etc. It is an umbellifer like the Carrot, with a slender but tough and string-like root. The following is a brief history of the "Student" parsnip, still the "best in the trade." Professor James Buckman collected seed from wild plants and sowed them in the botanic gardens adjoining the Agricultural College at Cirencester in 1847. The seeds grew apace in the highly nutritive soil, and in three generations looked like the smaller figure in Fig. 30. The Professor each autumn selected the best root for the next season's seed. In 1851 he gave the seed to Messrs. Sutton and Sons, of Reading, and after still further improvement they finally issued it to the trade. The figure shows what the "Student"

became in comparison with the condition reached by Professor Buckman (Fig. 30).

The Wild Carrot (Fig. 31) has a similar slender, wiry root. M. Vilmorin experimented with this. He sowed

FIG. 31.—Wild Carrot.

the seed of the wild plant in a good soil, and the roots soon began to increase in size, the foliage also enlarged, as they did with the Parsnip. This implies a greater power of making food, over and above what the plant requires for its annual growth and the production of

seed. The root enlarges to store it up. M. Vilmorin noticed that the carrot plants blossomed at different times, so he selected seed from the latest in flowering. The offspring sometimes failed to flower the first year, so keeping these, they became *biennials* and blossomed

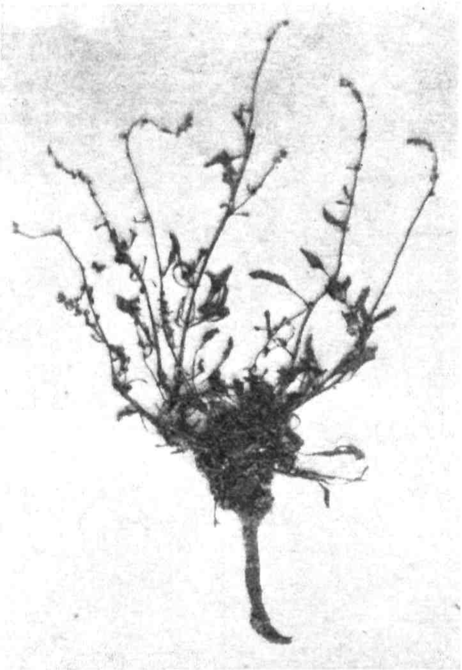


FIG. 32.—Wild Beet-root.

regularly the second year. Like Professor Buckman he turned annuals into biennials, and they have remained so ever since.

The Beet-root is naturally a perennial in the wild state, as shown in Fig. 32, by the massive root-stock

above the tapering root. Treating the seed in the same way, the cultivated plant is now a biennial also, and has given rise to various forms, the Mangold Wurzel being an agricultural variety of beet.

A peculiarity of the Beet, Parsnip, and Carrot is that they abound in sugar as reserve food material for the plant, to be utilised when the fruiting stage is reached. Potatoes, on the other hand, have their cells full of starch ; both starch and sugar are interchangeable, being composed of carbon united with the elements of water (hydrogen and oxygen), so that they have no flesh-forming properties which require nitrogen.

Beet has been long cultivated for the sugar alone on the Continent, and is now being tried in England. These carbohydrates, as chemists call them, are the product of "assimilation" of carbonic acid gas from the atmosphere. The first *visible* result is starch grains sticking to the minute green corpuscles in the cells of the leaves when exposed to sunlight, but as starch is insoluble the plant converts it into sugar, which is then dissolved and travels to growing parts to supply the material of the cell-walls, and the surplus is stored up in roots and tubers.

Two chief forms of roots are the globular and the elongated. These result from differences of the soils in which the seed is sown. Thus, Pliny tells us (about the year 20, in the first century) that the Greeks had discovered how to change the rape into the turnip, these being varieties of the same plant (*Brassica campestris*), by sowing the seed in a stiff soil; which presumably prevents the root descending and acquiring the elongated type, but instead grows laterally, assuming the turnip form.

We shall be pretty sure to see onions of sorts growing. These belong to the genus *Allium*. We have eight species wild. Most of them are rather rare, but the Ramsons perhaps are the commonest. They grow in woods, hedgebanks, etc., with ovate-lanceolate shaped leaves.

It bears, like most of the other species, numbers of whit flowers. The Leek (*A. Ampeloprasum*) is occasionall found in dry places. Hooker says from York an Lancaster to Fife and Perth. It is the origin of th cultivated leek. Like others, it has a bulb when growin

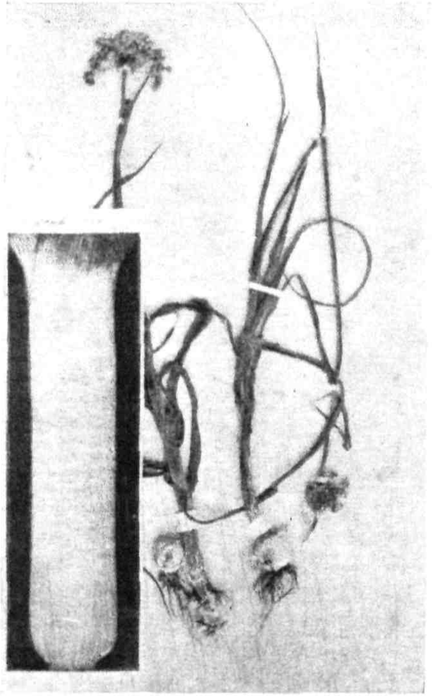


FIG. 33.—Wild and Cultivated Leek.

wild, as in the dry fields of Malta, but under cultivation it has lost it. Fig. 33 shows the difference. Now and then the Leek will revert to the bulbous form, probably in consequence of unusual drought.

Another species is called Chives (*A. Schœnoprasum*).

It is found along the west coast from Cornwall to Northumberland, but very rarely. The leaves are very narrow and resemble rushes, hence the Latin name meaning "rush-leek." Two species (*A. vineale*), the Field Garlic and (*A. oleraceum*) the Crow Garlic, have the remarkable habit of producing bulbs in place of some of the flowers. These, when they fall down, are capable of propagating the plant, but neither species is common.

Like all bulbous plants, they live naturally in dry situations, the swollen bases of the leaves constituting the bulb and acting as a storehouse for water, sugar, or starch, etc., to enable the plants to live through the dry season. This is why the great families of the Lily, the Daffodil, the Iris, etc., are mostly bulbous plants. They abound in South Africa in the hard dry "Karroos" beyond the Cape of Good Hope, where rain falls only during three months in the year. Moreover, as their ancestors were undoubtedly aquatic plants, their ingrained requirement is, above all things, plenty of water. Many are still water-plants, and all kinds thrive best with plenty of water. Even some Pelargoniums have become bulbous plants at the Cape.

Perhaps we shall see some Seakale and Asparagus in the garden, both of these being wild on our sea-coasts. It is the undeveloped shoots which are edible, enlarged by the enrichment of the soil. As salt tends to make all maritime plants thick and fleshy, it is customary to sprinkle it over an asparagus bed when the shoots are growing. The asparagus has long creeping stems, bearing minute scales in the place of leaves, but it produces green, needle-like *branches* in lieu of true leaves. The whorls of the flowers are in threes, characteristic of Monocotyledons, as it belongs to the Lily family. It has globular scarlet berries.

Unlike the asparagus, which is inedible unless cultivated, the Seakale (*Crambe maritima*) has long been eaten wild. It has been cultivated about two hundred

years. To improve the shoots for eating, they are grown in the dark, so that they never turn green, but are tender.

Celery (*Apium graveolens*) will also be seen growing in trenches, to be earthed in as the plant grows up, in order to bleach the leaf-stalks, and so prevent the deleterious property characteristic of the wild plant from being developed. It grows in marshy places, as in ditches, etc., chiefly by the sea. It can be detected by its strong scent, especially when bruised. It is an umbellifer, bearing greenish-white flowers.

Corn-cockle.

Bladder Campion.

RAMBLE VI

IN WASTE PLACES

BY-WAYS will often lead us into waste ground, as around farmyards, neglected bits of garden land, corners of arable fields, etc. These have their own special inhabitants. Let us see what we can find. The creeping Buttercup (*Ranunculus repens*) is the first we meet, with runners like those of a strawberry; but I have found it growing amongst tall ferns, and as it could not "run," the shoots all stood erect to get the light between the fronds of the ferns; showing how readily plants can adapt themselves to circumstances. Poppies may be there, escaped from some adjoining cornfield. It was in a little piece of waste garden ground where the Rev. W. Wilks, Secretary of the Royal Horticultural Society, found the original stray wild poppy with a white rim to the petals, from this individual he raised the celebrated "Shirley Poppies," described above.

Of composites, Thistles, of which we have many kinds, are common in waste places. Perhaps the commonest is the Creeping Thistle (*Cnicus arvensis* (Pl. XVI)). It has an underground stem and very spiny leaves with heads of dingy purple florets. This is a third type of the family, for *all* the florets have a tubular, five-toothed corolla.

The Burdock (*Arctium Lappa,* var. *minus,* also in Pl. XVI.) is a stout biennial, the lower leaves being very large. The heads resemble those of thistles.

"The young stalks were formerly eaten boiled and as salad" (Hooker).

It was regarded as a valuable remedy for stone in the Middle Ages, and called Bardona. As a rule the recipes for stone contained some seeds or fruits of a "stony" character, as gromel seed, ivy berries, and nearly always saxifrage, *i.e.* "stone-breaker." Even date-stones had to be pounded and taken; the idea being that what is naturally "stony" would cure it; that "like cures like."

The Great Mullein (*Verbascum Thapsus,* Fig. 34) is one of our tall wild flowers, remarkable for its dense spike of yellow five-petalled flowers, and woolly leaves. It is included in the Foxglove family, though most of the genera of which have four stamens, the posterior one having been arrested; the Mullein has five, though the posterior are smaller than those in front. Hence it stands in an intermediate position between the Potato and Foxglove families.

FIG. 34.—Great Mullein.

The soft thick leaves are employed in medicine as emollient when boiled in milk; but the seeds have some injurious properties, for they have been used for stupefying fish.

We have five species, all of them frequenting waste places. One is covered with a sort of "meal," really composed of a mass of short woolly hairs; hence called *V. pulverulentum.* It is only found in Norfolk and Suffolk. It is a native of Holland and Belgium, whence it was doubtless derived.

A yellow-flowered plant called the Celandine (*Cheli-*

donium majus (Fig. 35)), with four petals and an orange juice, is always found near villages. It was formerly grown as a drug-plant, when doctors of olden times thought nature herself showed which plants were useful to cure complaints by some sort of resemblance; hence the colour of the juice was supposed to signify that it

Fig. 35.—Celandine.

would be good for jaundice! Of course no one believes in such ideas now.

The London Rocket occurs in some places, recorded as wild at Berwick and Dublin, but it has become established elsewhere. It is a "Crucifer" with small yellow flowers and spear-shaped leaves. Its English name is derived from the fact that after the great fire of London in 1667, it appeared in great abundance. A similar

occurrence took place at Oxford in 1835. A quantity of rubbish was burnt in the Botanic Gardens; the ashes were spread over the ground, which was then trenched. "In a short time, the very spot on which the rubbish

FIG. 36.—Henbane.

was burnt produced an abundant crop of *Sisymbrium Irio*, the London Rocket." *

A common weed in waste places, and too common as a garden weed already alluded to, is the Black Nightshade (*Solanum nigrum*). It is a herb about a

* Baxter's *British Genera of Plants*, Vol. II., No. 146.

foot in height, with lance-like leaves, drooping clusters of small white flowers and purple-black berries. It is self-fertilising and multiplies rapidly, if not pulled up when in flower.

The Potato (*S. tuberosum*) is of the same genus ; as also the wild Woody Nightshade or Bitter-sweet (*S. Dulcamara*), a scrambling climber over hedges, etc., noticeable for its purple flowers with a coherent column of yellow anthers and scarlet berries.

There is a deleterious principle called *Solanine* in all the species of *Solanum*. The name Bitter-sweet is due to the fact that if chewed the stem at first tastes bitter, then sweet. The berries are very harmful. Children have died in consequence, as well as from eating the scarlet berries of the Lords and Ladies. The poison is that of an acrid narcotic kind.

Two important medicinal plants occur in waste places, both of the Potato family, and very poisonous. One is the Henbane (*Hyoscyamus niger* (Fig. 36)), the other Dwale or Deadly Nightshade. The former grows about one to two feet high, has very sticky leaves with a strong disagreeable scent. The flower is tubular, about one inch or more across, dull yellow veined with purple. The fruit is peculiar, being a dry capsule, which splits round the top, which comes off like a cap, as described in the plantain. The flowers stand like hanging bells ; the name *henne-belle* is Anglo-Saxon, and it came to be called *symphoniana*. It was used with other drugs to induce sleep for operations in the Middle Ages.

Dwale, Belladonna, or Deadly Nightshade (*Atropa Belladonna* (Fig. 37)) forms almost a bush. It is smooth-leaved, having dull violet bell-shaped flowers and dark purple berries. The second name is derived from the practice of South European ladies who used the juice to give brilliancy to their eyes. Dwale was the name for the sedative drug up to the fifteenth century ; but it appears to have then fallen into disuse.

A third member of this very poisonous group of the Potato family is the Thorn-apple (*Datura Stramonium* (Fig. 38)), introduced from South America in the sixteenth century. It is a large annual plant with trumpet-like white flowers. The oblong capsules are covered with

FIG. 37.—Deadly Nightshade.

spines, hence the English name. Though the whole plant is poisonous, the black seeds are most deadly. A purple-flowered variety (*D. Tatula*) is not infrequently grown in gardens.

The plant is strongly narcotic, and used in medicine

as an anodyne. It seems that it has good effects in neuralgia and rheumatism, but the plant should never be used except by a medical practitioner.

FIG. 38.—Thorn-apple.

There is a small kind of Stinging Nettle (*Urtica urens*), about a foot in height, common in neglected gardens and waste ground. It is an annual, not a perennial with the underground creeping stems of the tall species. It has small green flowers, the male consisting of a calyx of four sepals with four stamens, and a similar female flower with a single carpel. The filaments of the stamens of nettles are highly elastic as described in the Pellitory, being curved inwards in bud. When the sepals open out, they are liberated, springing up and curving the reverse way. This enables the pollen to be thrown into the air, as no insects visit the flowers.

The sting consists of an elongated cone of cells, hollow within, the "poison bag" being at the base. On touching the hand the tip breaks off, enters a pore of the skin, and the juice is pressed into it.

Besides the Groundsel (*Senecio vulgaris*) there is another species not very unlike it, but it grows taller and has a more or less distinct ray. It seems common in the south coast districts. It is very abundant about Bournemouth.

Another species, the Ragwort, is common everywhere on waste ground. It is a tall plant, sometimes nearly four feet in height. The heads are in dense clusters, with both ray and disk florets, both being yellow. The name *Senecio* is derived from the Latin word *senex*,

meaning "old man," an allusion to the white, silky hairs making the pappus.

Both these two species were formerly regarded as medicinal, but they do not appear to be of any value. It seems strange that in the fifteenth century the Groundsel was cultivated for its supposed virtues!

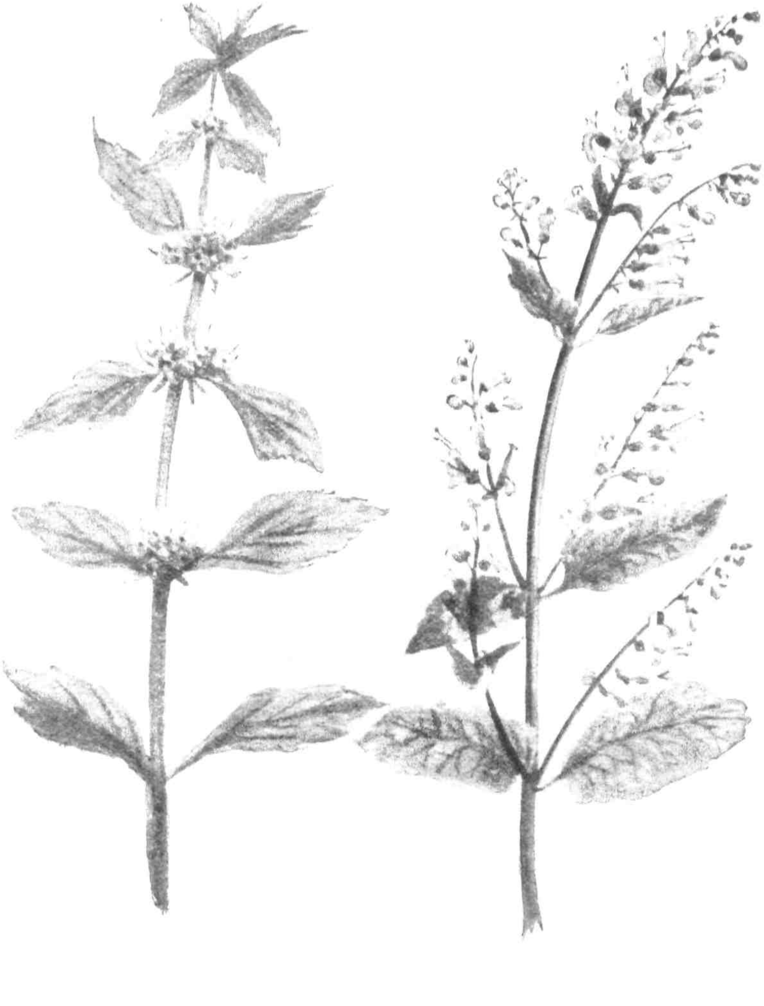
This species is self-fertile, as the style with its two stigmas do not emerge from the flower, but remains within the anther-tube and receives the pollen at once, as the anthers burst inwards. This accounts for its great fertility as a garden and troublesome weed. Indeed, it derives its name from this fact, for it was originally grounde-swellye, *i.e.* "ground-swallower."

One of our commonest weeds in waste places is the White Goosefoot (*Chenopodium album*). It is a grey, mealy annual, bearing small green flowers, as there is no corolla, only a calyx of five green sepals with five stamens, one *in front of each sepal,* and a pistil of two carpels as shown by the two styles. The words in italics are important. The rule of flowers is that if the whorls have the same number of parts, each *alternates* in position with the next whorls. The stamens, therefore, are in their right places, for the *corolla has been suppressed.*

Many of the *Incompletæ* are similar in this respect; showing that such are degradations from corolla-bearing ancestors. There are reasons for thinking the Goosefoot family has descended from the Pink family, as they have a similarly curved embryo, etc.

A not uncommon escape from gardens into waste places is the large yellow-flowering Evening Primrose (*Œnothera biennis* (Fig. 39)). It was introduced from North America. It is so common now that Hooker has included it in his *Students' British Flora.*

It belongs to the same family as the Willow herbs and garden Fuchsias, Godetias, etc. The flower has its ovary invested by a receptacular tube, which is prolonged a long way above it, carrying the four sepals, four petals,



and eight stamens on the rim. The pollen-grains are peculiar in being grouped in fours, and clinging together by tenacious threads.

Another species, *Œ. odorata*, is found wild in the South

FIG. 39.—Evening Primrose.

of England, but only as a garden escape. It grows to two feet in height, with purplish stem and yellow flowers, three to four inches across. They are sweet smelling, hence the specific name.

A small species of Lettuce (*Lactuca muralis*) is

somewhat rare in England. The specific name implies that it grows on walls. It has much divided leaves and small heads of yellow flowers like those of a dandelion; two others occur in waste ground, one only being common (*L. virosa*). It grows from three to six feet high, is prickly, smooth-leaved, the leaves being from six to eighteen inches long; the heads are small and yellow. They all have the milky juice characteristic of composites, having *all* the florets with strap-shaped corollas. Another species or variety of the last named (*L. Scariola* (Fig. 40)) occurs in waste places. It is regarded as the origin of the garden lettuce; but it is not at all common. It has a wide distribution, as Hooker gives Europe, Siberia, and Himalaya; introduced into North America. The late Dr. Sickenbenger, Professor of Botany in the Medical School at Cairo, found it in Upper Egypt.

FIG. 40.—Garden Lettuce.

A small degenerate plant on waste ground, roadsides, etc., is the Pearlwort. It is a member of the Pink family, the petals being much smaller than the small sepals. The anthers cluster round the stigmas, clearly indicating self-pollination.

Another plant also degraded by impoverishment is the grass Mat-weed (*Nardus stricta* (Fig. 41)). Comparing this with wheat (Pl. XV.) one finds the spikelets form a unilateral spike, instead of being on two sides. Each is only one-flowered; and there are no scales or lodicules. There is only one instead of two stigmas. These are degradations caused by drought. These two, and many

more might be cited, show how evolution, or the production of species and genera, is sometimes consequent on impoverishment; for the arrest of certain organs can

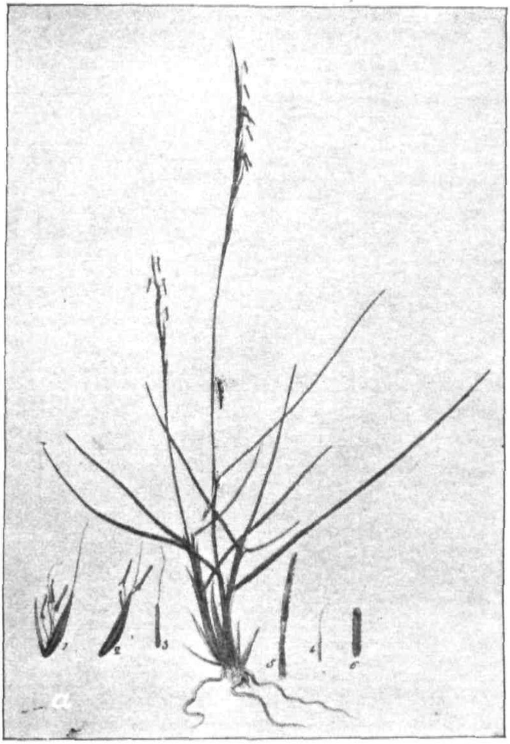


FIG. 41.—Mat-weed.

become hereditary and constant. Indeed, certain species of plants are named *depauperata* in consequence.

The Shepherd's Purse (*Capsella Bursa-pastoris*) is one of our commonest and ubiquitous weeds. It has a rosette of leaves on the ground and a slender stem, bearing

a *raceme* of small white flowers. A raceme, as shown in the illustration (Fig. 42), has a main stalk, the *peduncle*, and smaller *pedicels* which bear the flowers. It is a crucifer, having four sepals, four petals, six stamens, of which four in the middle are taller than the two lateral ones. The pistil has two carpels united, terminating in a style with a globular stigma. The flower is self-fertilising and sets an abundance of seed. The fruit of all crucifers is peculiar; the two carpels have their edges united, leaving the ovary hollow. It is as if two leaves were laid face to face and their margins united. As the seed-bearing margins are double, there will be four rows of seeds. In addition, four thin plates grow right across the ovary, uniting in the middle, having half the seeds on one side and half on the other. In a garden crucifer called Honesty, with mauve-coloured flowers, the pods are an inch or more across; and when the "valves" have fallen, this silvery plate is left on the stalk; so that sprays are often used for decorative purposes.

We have two introduced species of Alkanet (*Anchusa*), one of which is used for staining wood, etc. This species is *A. tinctoria*. Our British allies are *A. arvensis* (native) and *A. officinalis* and *A. sempervirens* (introduced). Both are found in waste places, such as ballast heaps—a common source of many introduced plants. Borage (*Borago officinalis*) is also a foreigner, being a common South European weed.

The rambler will notice the peculiar inflorescence of these and other members of the Borage family, as the Forget-me-not, how it is curled up when the flowers are in bud, but uncurls and straightens itself in fruit. Hence the old name of the Forget-me-not (*Myosotis palustris*) was Scorpion-grass; though *myosotis* is Greek for "Mouse-ear," from their supposed resemblance of the leaves to it.

The foliage of nearly all of the Borage family are excessively rough with stiff hairs.

Besides the Borage, the Viper's Bugloss (*Echium vulgare*) is also found on waste ground. The flowers are purple and slightly inclined to be lipped, the stamens projecting and *declinate* in adaptation to insects which alight upon them. The Comfrey will be referred to in speaking of water-sides, as well as the Forget-me-not. The Hound's-tongue (*Cynoglossum officinale*), however, is often

FIG. 42.—Fumitory.

in waste places as well as fields. The flowers are small, dull red-purple in colour. The plant has a fœtid odour, smelling like mice. It has the usual rough foliage of all the Borage family. Though formerly used in medicine as narcotic and astringent, it is now discarded on account of its fœtid odour.

The common Fumitory (*Fumaria officinalis* (Fig. 42))

is a slender straggling plant with much divided leaves of a bluish-green colour. Many flowers grow on a common stalk of a pink colour. They are about half an inch long. They have two small sepals, four petals in two very dissimilar pairs ; the two outer are larger, really lateral ; but they become antero-posterior by a quarter-twist of the little stalk, one being pouched. The two inner are erect, and coherent at the tips. There are six stamens in two bundles ; the anther of the middle stamen in each bundle is two-celled, the other two are one-celled. It is very seldom visited by insects, as so many other conspicuous flowers are open at the same time. It is, however, self-fertile and sets every seed.

The name is a corruption of *Fumus terræ*, *i.e.* earth-smoke, as it was called in the fourteenth century.

The common biennial Stinging Nettle of all waste ground is the largest of our three kinds. It is called *Urtica dioica*, a word meaning "two houses," for the staminate flowers are not on the same plant with the pistillate, though they are on the small annual weed of gardens (*U. urens*). The third or Roman Nettle (*U. pilulifera*) is said to have been brought by the Romans. The flowers make little pill-like clusters. The antiquary Camden records in his work *Britannia* that this nettle was common at Romney. Here, or near it, Julius Cæsar landed, and called it, so it was said, *Romania*, from which Romney is a corruption. Camden's words are : "The soldiers brought some of the nettle seed with them, and sowed it there for their use, to rub and chafe their limbs, when through extreme cold should they be stiff and benumbed, having been told that the climate of Britain was so cold that it was not to be endured."

Wormwood (*Artemisia Absinthium*) is an inhabitant of waste places, but local. The leaves are silky on both sides, the flowers being in small yellow heads, with no ray florets. The wormwood of Scripture is probably *A. Judaica*, found in the deserts near Cairo, Suez, and

Palestine. They are all very strong-scented. The old-fashioned garden Southern-wood comes from South Europe. It was customary in the early part of the last century to place a bunch of Southern-wood and rue before a prisoner in the dock to ward off the jail-fever. Experiments have shown that this idea was correct, as the strong aromas of many plants are inimical to bacteria.

Another species is Taragon (*A. Dracunculus*), of Siberia; and the English wild flower Mugwort (*A. vulgaris*), so called because a spray used to be put into ale.

Wormseed (*A. maritimum*) is an inhabitant of salt marshes and is used in medicine.

Borage (*Borago officinalis*), which supplies the name of the family Boragineæ, is not a native, but found in waste ground near habitations; for it has long been cultivated. It is a native of South Europe and frequent as a roadside weed in Malta. It has a flat "rotate" corolla, *i.e.* wheel-like in technical language, of a bright blue colour with long purple-black anthers, spurred at the back. It was used in the Middle Ages as a cordial. Gerard (1597) says of it: "Those of our time do use the flowers in salads, to exhilarate and make the mind glade. There be also many things made of them, used everywhere for the comfort of the hart, for the driving away of sorrowe and increasing the joie of the minde." He adds that "the leaf of Burrage hath an excellent spirit to repress the fuliginous vapour of dusky melancholie!"

Borage does not appear, however, to have any virtues at all.

Of Umbellifers, the Goat-, Gout-, or Bishop's-weed (*Ægopodium Podagraria*) is perhaps the commonest inhabitant of waste places, being often found by old ruins of monasteries, etc., suggesting its possible introduction in the Middle Ages as a drug-plant. For it was considered a valuable cure for gout, but it does not appear to have any real medical properties. It has a creeping underground stem, which renders it very troublesome

and difficult to eradicate, if it invades a garden. The leaves are twice divided into three broad leaflets. The umbels bear white-petalled flowers; the whole plant grows close to the ground, being rarely two feet in height.

Numerous species of Thistle comprise the two genera *Carduus* and *Cnicus*, called "pilose" and "plumose" respectively, because the "down" or pappus is composed of simple hairs in the former and branched or feather-like hairs in the latter. We have three species of the *Carduus* and eight of *Cnicus*. Three or four of these often occur in waste places. They all belong to the group of composites with no ray florets, all the heads having them tubular and alike.

One kind is called the Cotton Thistle (*Onopordon Acanthium*). This is a tall cottony biennial reaching five feet in height. The stem is spiny and with "wings" to the tip. The head is two inches in diameter. The flowers being pale purple. Another is the Milk Thistle (*Silybum Marianum*), not truly indigenous. The leaves are large with white nerves. It is a native in the countries bordering the Mediterranean. The stalks have often been eaten, being palatable and nutritious. It was formerly cultivated, for "the young shoots in the spring cut close to the root with part of the stalk is one of the best boiling salads that is eaten and surpasses the finest cabbage" (Bryant). This species, we are told, has spread over large tracts of country in Australia, having been introduced accidentally by the settlers, and forms one of the most troublesome weeds in the southern colony and Victoria, where acts of legislature have been passed to compel the farmers to destroy these intruders.

Two Labiates are frequenters of waste places, the Horehound (*Marrubium vulgare*) and the Catmint (*Nepeta Cataria*). The first is a perennial about two feet in height with woolly leaves, roundish-ovate in form. It bears close whorls of small yellowish flowers. It was considered

Wheat.

of old to be very useful in cases of catarrhal cough and in pulmonary complaints.

The Catmint has a stem two feet in height; the floral clusters make a terminal, crowded spike. The flowers are pale pink in colour with red spots. Cats are so fond of the odour that they will destroy and tear to pieces any plant of it in a garden that may happen to be bruised, so as to emit its peculiar pungent scent, and they seem to delight in this almost as much as they do that of Valerian.

Our only species of Vervain or Verbena (*V. officinalis*) is common in waste ground. It has a slender but wiry stem about two feet in height, divided leaves and dense-flowered spikes. The flowers are small and lilac in colour. It differs from Labiates in not having the ovary lobed.

This plant was much over-rated in former days as a medicinal herb, as being curative of many complaints, though it is only slightly astringent. It was called by the Greeks "Holy Herb," and used for incantations. It was called the "simplers' joy" by later herballists, from the readiness with which it can be found; for it generally grows near habitations, having been cultivated, in all probability, in herb gardens.

It is our only ally of the garden verbenas, which are natives of South America, at Peru as well as Mexico, and other places; numerous species are now cultivated.

RAMBLE VII

Through Marsh-land

As we go down from the higher and drier ground towards the river we pass through damper or even marshy ground. Many plants delight in these conditions of the soil. We will look for some of the more interesting sorts.

A handsome plant, long cultivated as a garden plant, is the Aconite (*Aconitum Napellus* (Fig. 43)). It is found wild near streams in the West of England only. It grows to two or more feet in height, with blue flowers. The calyx is coloured blue and has the posterior sepal in the form of a hood, hence the additional name of Monk's-hood. It is a most deadly poisonous plant. It has conical dark-coloured roots, which have been eaten instead of horse-radish, and, consequently, whole families have been poisoned. Even chewing a flower has proved fatal.

Fig. 43.—Aconite.

The earliest of all the species of *Ranunculus*, or Buttercups, is the Lesser Celandine (*R. Ficaria* (Pl. XVII.)). It has heart-shaped leaves, quite smooth, and narrow golden petals (1), looking as if varnished. They vary in number,

but eight or nine is most usual. There are only three sepals.

In shady places it produces little "corms," or solid balls like pills, in the axils of the leaves, which can grow into new plants when they reach the soil on the plant decaying.

It is in its general appearance very unlike a true buttercup; but the numerous stamens (2) and carpels (3) which turn into achenes, exactly recalls the structure of the flower of the field buttercups (Fig. 1).

It is an interesting plant, as intimating a transition between Dicotyledons and Monocotyledons, for the following reasons:—

It is not only singular in having heart-shaped leaves, characteristic of the floating kind of some water-plants, but the stem and leaf-stalks abound with air-chambers, found in all truly aquatic plants when submerged. Lastly, it has only one cotyledon! The position of the leaves and the three sepals are suggestive of members of the Monocotyledons; but the structure of the flower so closely agrees with that of buttercups, that botanists have kept it in the family which is dicotyledonous.

As there is no tap-root, as in all aquatic and Monocotyledons, the roots come out of the thick base of the stem. Buds also issue from it, associated with a thick or swollen root, which is filled with water and starch, etc., to nourish the young plant when detached from the parent after its decay. This is a procedure common in Monocotyledons, which are often propagated by bulbils, as in lilies, onions, tulips, etc.

That water arrests the primary or tap-root of Dicotyledons may easily be proved by a simple experiment. Fig. 44 is that of some mustard seed germinating on a piece of muslin suspended over, and just touching, the surface of water. It will be seen how the root end is "blunt," for the root is not developed and the stump is really the stem from which new secondary roots are

developed. If a grain of Indian corn be grown, the axial root is developed, but soon perishes as the stem grows thicker; then the secondary "adventitious" roots, as they are called, all come out at the joints or nodes, and so support the stem like tent-ropes, at the same time deriving moisture and mineral foods from the soil.

This is one of many coincidences between Monocotyledons and aquatic Dicotyledons, whether they be

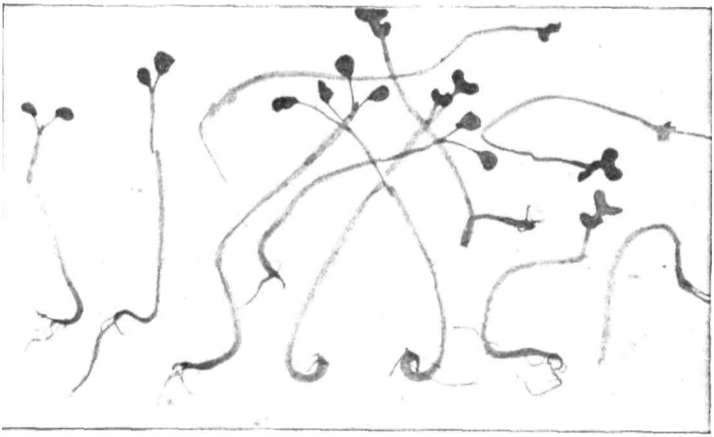


Fig. 44.—Mustard germinating over Water.

aquatic now or not, which shows that they have descended from the latter. We shall find other resemblances later on.

The Marsh Marigold (*Caltha palustris*) is a very common frequenter of very wet ground. It has large rounded leaves and flowers, one to two inches across, of a golden-yellow colour. The observer will soon discover that it has no corolla; for the pseudo-petals are green in the bud, being really the calyx. There are numerous stamens and carpels, as the plant belongs to the Buttercup family.

We have seen that honey is secreted by the petals in buttercups, which are really transformed anthers; but

the honey-glands are borne in the sides of the ovaries of the carpels in the Marsh Marigold, which are elongated and bear many ovules, like pea-pods.

A double-flowered variety is cultivated in gardens. There is a very rare species of *Caltha* (*C. radicans*) found in Forfarshire, with sub-triangular leaves with a toothed margin.

The Butter-bur (*Petasites vulgaris*) is a marsh-plant closely allied to the Colt's-foot which prefers dry places, as roadsides, waste ground, etc. The latter has yellow flowers; the former, spikes of rose-coloured "heads." The leaves often grow to a yard in diameter, and nearly round in shape. It is not so common as its ally the Colt's-foot. This latter flowers very early *before* the woolly leaves appear; the Butter-bur produces its leaves also after the flowers. The sexes are in different "florets." The style of the male has the two stigmas united, thus forming a club-like structure, which thrusts out the pollen from the anthers just as ordinary composites do, but has no power to be fertilised, as the stigmas do not spread out to receive the pollen. Hence it must be received from other florets. The Butter-bur has the heads in racemes, and outer flowers tubular; while the Colt's-foot has the heads solitary, and distinct and ligulate ray florets.

Of other composites, Hemp Agrimony (*Eupatorium cannabinum*) may be looked for. It is a shrubby plant, two to four feet high, with opposite compound leaves. It is hairy like the Great Willow-herb, a rather unusual condition for semi-aquatic plants. The heads are small in dense clusters, with only five or six florets, all alike and tubular. It has a white rough pappus. It was formerly regarded as a medicinal plant as a febrifuge, but has fallen into disuse.

Two native species of *Senecio*, the genus to which the common Groundsel belongs, are aquatic or marsh plants. *S. aquaticus* is a tall biennial. It resembles the Ragwort (*S. Jacobœa*), but the heads are larger; and *S. paludosus*,

only occurring rarely in the fens of East Anglia. The leaves are undivided.

The Gipsy-wort (*Lycopus europæus*) is not uncommon by ditches and banks of rivers. It is a labiate, and therefore has a square stem and opposite leaves. There are many whorls of flowers; the corolla is very small, about one-eighth of an inch, bluish white, dotted with purple.

There are two other labiates, the Greater and the Lesser Skull-cap (*Scutellaria galericulata* and *S. minor* (Pl. XXI.)); the former grows to eighteen inches, the latter only to six inches. The peculiarity by which they can be recognised is the calyx, which is bell-shaped, lipped, the tube being "dilated opposite to the posterior lip into a broad, flattened, hollow pouch, the lip and pouch being deciduous in fruit and the mouth closed after flowering" (Hooker). The corolla is blue, varigated with white inside.

Hooker adds: "A hybrid (?) with *S. minor* is common at Virginia Water, Surrey, intermediate in habit and flowers between the two species."

The only insect known to visit the first species is a butterfly.

One more little plant may be mentioned for the benefit of ramblers in Cornwall to South Wales, or along the south coast, as it is native of France, Spain, and Portugal as well as the Channel Islands, *Sibthorpia europæa*, named after Dr. Sibthorp, an Oxford Professor of Botany. It is a rare plant, growing in clumps. It is very slender and creeping. The leaves are seven to nine lobed. The flowers are very minute, the corolla is "sub-rotate," *i.e.* somewhat wheel-like, as in the Forget-me-not, having a flattened limb with a very short tube. Though very unlike a Foxglove it belongs to the same family. As an instance of its occurrence, it used to grow on the moist bank in a lane behind Tregenna Castle Hotel, St. Ives.

Not far off by the roadside was a large plant of the Horse-mint (*Mentha sylvatris*), a rare plant, and the supposed origin of the cultivated mint.

Two orchids may be found in marshy ground, but they are local. The Marsh Helleborine (*Epipactis palustris*) is about eighteen inches high, with green and purple flowers, though the tip is red with a white streak. The other is the Marsh Orchis (*O. latifolia*). Like the spotted orchis its leaves have also purple spots. The flowers are dull purple, with the tip spotted.

There are three or four other monocotyledonous herbs which may be mentioned, but they are not common—the Snowdrop, the Snowflake, and the Snake's-head or Fritillary. The first is considered to be wild in Hereford and Denbigh, but naturalised elsewhere (Hooker). The Snowflake differs from the Snowdrop in having the sepals and petals nearly equal in size, and tipped with green. It is reputed as being found in "wet meadows and osier holes" in South-East England. The Snake's-head has a drooping bell-like flower; the curious square purple and white markings like a chessboard make it very distinguishable. Its range is "from Norfolk and Stafford to Somerset and Hants." All three are familiar garden flowers.

Rushes, growing in tufts, are very common in wet meadows. They do not at first sight suggest much resemblance to lilies and tulips; but the Rush and Lily families are closely allied.

If a flower be picked from the brown clusters on the stem, it will be found to have six brown scales (representing calyx and corolla, or perianth), six stamens, and a pistil of three carpels; precisely as in a tulip. If the stem be cut open, the inner tissue is found to be full of air passages, for each individual cell is star-shaped, and the cells are united by joining the rays of the stars. All aquatic and semi-aquatic plants require to be aërated, as the roots being in mud or water cannot get sufficient oxygen; so nature adopts various means of storing it up in the stem, etc.; and also by bringing certain roots up into the air like a bent knee or pole, etc., of foreign trees,

etc. Our Marsh Samphire is provided with aëriferous tissue, as will be explained in our seaside rambles.

The Bur-marigold is a semi-aquatic plant. We have two species, one with the heads drooping and undivided leaves (*Bidens cernua*), and the other with leaves cleft into three divisions. The heads are from one to one and a half inches diameter, and yellow, generally, without the ray florets.

If the anatomical structure of the roots and stem of a plant growing *in the water* be contrasted with similar parts of an individual growing *on dry ground*, they will be very different. The plants being annuals, it is easy to realise how profoundly the external conditions affected the growing seedling, by their responding to them, respectively; so that in the full-grown state each is perfectly adapted to its environment.

A member of the Borage family is very common by river-banks and watery places, viz. the Comfrey. It has rather large, rough leaves, and grows to about three feet high, being a coarse herb. It bears a drooping cluster of tubular flowers, pale yellow or purple. It was a former drug plant, and the young leaves are sometimes cooked. The name is said to be derived from *con-firma*, in allusion to the uniting of bones, since it was also called *consolida*, or knytte-wort, having been used for wounds.

Another member of the same family as the last, is the Forget-me-not. Of the six English species two are inhabitants of water or marshes. It is too familiar to the reader to require description. It was called Scorpion-grass, on account of the peculiar way the flower stalk curves at the tip like a scorpion's tail, before the buds open; as they expand the stalk gradually straightens itself. The curling stalk was supposed to indicate its curative powers against scorpion stings.

A species of Violet (*Viola palustris*) is not uncommon in the north, but rarer in southern counties. It has very

Creeping Thistle.

(*Cnicus arvensis*).

smooth leaves, as is usually the case with semi-aquatic plants. The flowers are white or lilac, and scentless.

Creeping Jenny (*Lysimachia Nummularia*) is pretty sure to be on the river-bank. It is a member of the Primrose family, very smooth, and growing to two feet or more, bearing opposite leaves and a single flower at the joint, of a golden yellow colour. It is a favourite in gardens where it can have a moist bank to cover.

The Winter-cress (*Barbarea vulgaris*) is an erect, smooth biennial, with yellow cruciform flowers, being a member of the Crucifer family.

It was formerly cultivated as an early salad; the outer leaves were picked as the plant continued to grow. By cutting off the flowering stalks as they appear, fresh leaf-buds arise, and so supply a continuance for the salad.

Every one is familiar with the little strong-scented musk plant; but a species of the genus (*Mimulus luteus*) has been introduced from North America with large yellow flowers, and "escaped" into several rivers of England, growing by the side, as it is a great water-lover. A hybrid between the musk and this species, which has no scent, has been cultivated. It retains the large flower, but in addition, the scent of the musk has been acquired.

Fig. 45.—Figwort.

Another plant of the same family (that of the Foxglove and Toad-flax) grows by river-sides, called the Figwort (*Scrophularia nodosa* (Fig. 45)). It is about four feet high, leaves about three to eight inches long, and bears bunches of small, brownish, gaping flowers.

They are fertilised by wasps. The Latin name implies its formerly supposed virtues.

Two plants of the cultivated Buckwheat family and of the knotgrass genus (*Polygonum*) are aquatic and marshy kinds. The latter is the Snake-root or Bistort (*P. Bistorta*). Though there is no corolla to any of the species, yet the present one is attractive to insects as the calyx is pink, and there is honey ready for them. This one grows in wet meadows. The other species is *P. amphibium*, because, like the Bur-marigold and lesser Spearwort, it is amphibious, just as described in the former; this species of *polygonum* changes its structure in several ways to adapt itself either to water or land.

Two or three species of Dock, which is akin to the polygonums, grow in water; one grows to a height of six feet, with large leaves and a very large bunch or "panicle" of green flowers; for it has no corolla. Unlike most Dicotyledons, it has its parts in threes, not fives, namely, six sepals, six stamens and a three-cornered fruit. All the sepals have tubercles on them. This species is called the Great Water Dock, the Latin name being *Rumex Hydrolapathum*. The Rhubarb (*Rheum*) belongs to the same family as the Docks. The name is derived from *Rha*, the old name for the river Volga.

Pliny, in describing the cultivation of Mint, observes that the original name with the Greeks was *Mintha*, "from which the Latin *Mentha* was derived; but of late it has been called *hedyosmon*," *i.e.* sweet-scented. He speaks of "a wild kind of mint known to us as *Mentastrum*." This name was used in the fourteenth century for the Watermint (*Mentha aquatica*), which smells strongly of peppermint; this latter being believed to be a cultivated form of it. Pliny seems to refer to it as follows: "The mint that is used in the dishes at rustic entertainments pervades the tables far and wide with its agreeable odour." Only peppermint is likely to do that.

A square stem with pairs of opposite leaves are two

characteristics of all Labiates, which are more or less scented; hence several are used as kitchen herbs, as thyme, basil, marjoram, sage, etc., and for perfumes, as lavender, patchouli, etc.

Three conspicuous and very familiar wild flowers grow by the water-side. They are the great hairy Willow-herb (*Epilobium hirsutum* (Fig. 22)), commonly called Codlins and Cream; the purple Loosestrife (*Lythrum Salicaria*). and the Meadow-sweet or Queen of the Meadows (*Spiræa Ulmaria*).

The Loosestrife is peculiar and requires description. It has a four-angled stem and grows to four or more feet in height, bearing masses of purple flowers making a dense spike. The calyx has six coherent sepals, with little additional points. There are twelve stamens, six long and six short. The pistil has two carpels producing many seeds.

The stamens and style curve downwards and then upwards as in the Willow-herb. The object of this is to give a support to the insect visitors, such as the larger bees and flies.

Now, the rambler must search for these three different kinds of flower, but always on *different* plants. In one kind the stigma is *below* both sets of six stamens; in others it reaches *halfway* between those; in others, the stigma is *beyond* the tallest stamen, *i.e.* of the same flower.

Comparing the three kinds of flowers together, it will be found that the ***shortest*** styles are of exactly the same length as the *shortest* stamens, the *longest* styles are of the same length as the longest stamens, and the ***mid-style*** form matches the third kind. This last has been found by Darwin to afford most seed when fertilised with pollen from stamens of the same length. If the shortest style receive pollen from the longest stamens, or the longest style from the shortest stamens, scarcely any seed is produced.

Three kinds of British trees favour water, the Willow, the Poplar, and the Alder.

The most familiar kind of the first is the Common Sallow or Goat Willow (Pl. XVIII.). The leaf has a pair of small stipules at the base (as shown). The male and female flowers, as also of the Poplars, are on separate trees; the male consisting of a bract including two stamens (1); the female consists of a pistil only (2); (3) is a section showing the position of the ovules, and (4) a hairy seed.

This extreme simplicity of the flowers seems to indicate an ancestral condition, and not necessarily a degradation from more perfect flowers. The fact that willows and poplars comprise a family of themselves, also indicates a long-lost ancestry, as they now have no immediate affinity with other trees.

Another marsh willow is called the Osier (*S. viminalis*). This is largely cultivated in swampy osier-beds. It may grow to thirty feet in height, but it is the short, slender shoots from the stem which are used for baskets, hampers, etc. It has long leaves, dark green above and silky-white below. This willow has been utilised from time immemorial; the ancient Britons used them for the skin-covered boats or coracles, round boats still in use in Wales.

We have only two native poplars, the White or Abele, with cottony leaves (*Populus alba*), and the Aspen (*P. tremula*). The Black Poplar is not native, but largely grown. Its natural form has spreading branches, but the "fastigiate" variety, the Lombardy poplar, with erect branches, is usually cultivated. The habit of the "trembling" of the leaves in the wind is due to the fact that the leaf-stalk is not cylindrical from one end to the other, but is flattened in the middle or nearly so; so that it can oscillate and twist about when blown by the wind.

All the poplars have the sexes separate on different trees; the staminate flowers are in long cylindrical catkins, with reddish scales and violet-coloured anthers. The pistillate catkins are shorter, with four stigmas to each pistil. The seeds have silky hairs, so that when the

capsules part and the catkins fall, they suggest the appearance of white silky caterpillars!

The Alder (*Alnus glutinosa*) is a bush or tree growing to forty feet in height, either beside the water or in it. It bears leaves from two to four inches in length, rather glutinous when young, hence the specific name; the catkins appear before the foliage. The male has peltate scales, with three flowers, the sepals and stamens three to five in number. The female catkins have scales, with two to three flowers. The fruiting catkins become woody when ripe, like miniature fir-cones.

The wood of the tree is durable when under water, consequently it is used for piles, embankments, etc. It is said that many buildings in Amsterdam and Venice are supported by it. It has also various uses, *e.g.* the bark, like that of the oak, is employed for tanning; and being astringent, is useful for relaxation of the throat. It has also been found capable of dyeing, as it gives a red or orange colour to cloth, etc.

Hitherto we have alluded to plants common to many ordinary river's sides; but some of our ramblers may live in the fen counties of East Anglia. So we will supplement the preceding with reference to such more or less interesting plants as may be found in the valleys through which the Yare and other rivers flow.

The fenland originated by the country being so flat that the rivers from more inland places could not carry their mud into the sea. Consequently they silted up. It is only by an extensive system of canals that this fruitful land has become arable for agriculture.

There are not always exactly the same plants in each river-valley. The following, for example, are abundant, more or less, along the Yare, which supplies the name Yarmouth.

Of grasses, there are the usual aquatic species, the Reed and the Flote. Then of dicotyledonous herbs, the Cuckoo flower (*Lychnis Flos-cuculi*). It is more

commonly called Ragged Robin, a kind of Campion, easily recognised by its divisions of the petals being long and coloured red. They form loose clusters. The Queen of the Meadows, or Meadow-sweet, is very abundant (*Spiræa Ulmaria*), with masses of sweet-scented, cream-coloured flowers. The medicinal plant Valerian (*Valeriana officinalis*) and the Marsh Bed-straw (*Galium palustre*). *Angelica sylvestris* is a tall umbellifer, growing to five feet, with the usual divided leaves, the segments being large, and the umbels rather globular in shape. An allied species, occasionally wild as an escape from cultivation, is *A. Archangelica*. The leaf-stalks of this make a green confection with crystallised sugar. In Lapland the natives peel the stalks and eat them raw. It was thought in former days that it had the power of averting pestilence, probably supposed to be the results of evil spirits, hence it acquired its specific name.

The Forget-me-not (*Myosotis palustris*) or its ally (*M. cæspitosa*), already referred to, may be looked for, as these are the only two species which frequent watery places and retain a bright green colour in consequence, not having the hairiness so characteristic of the others which frequent drier ground, and are consequently roughly hairy.

The Hog's Fennel (*Peucedanum*) has two species: one, *P. officinale*, very rare in Kent and Essex in salt marshes; the other, *P. palustre*, called Milk Parsley, is of local occurrence in the Eastern counties, and occurs in the Fen. Its juice is milky, hence its English name. It is an umbellifer with minute flowers. The root yields a yellow, fœtid gum-resin, but is used in Russia as a substitute for ginger. Species of Water Dropwort, one of which is described and figured (Fig. 11), are also abundant.

Besides the officinal Valerian described elsewhere, *Valeriana dioica* is to be found. It only grows to about eighteen inches in height, with very small pinkish flowers; the sexes are often separated. Thus the male flowers

have a larger corolla ; the female has the smaller flower, with abortive stamens, bearing no anthers.

The Yellow Loosestrife (*Lysimachia vulgaris*) is an erect, hairy-leaved plant, the leaves being opposite or whorled. The stem grows to four feet in height. The flowers, like those described of the Cowslip and Primrose—as it belongs to the same family—have two forms. The corolla is yellow, with orange dots within it.

Two orchids occur, the Marsh (*O. latifolia*, Lat. sp. *incarnata*) and the Marsh Helleborine (*Epipactis palustris*), referred to above.

Our two species of Helleborine have green flowers striped with white and purple or red. Darwin noticed that the species growing in woods, which has a dull purple appearance, is fertilised by wasps ; just as the Figwort (*Scrophularia*) is, being much of the same colour ; but Mr. W. E. Darwin says the Marsh Helleborine is visited and fertilised abundantly by the hive bees and by flies. Two German species have become quite self-fertile by the reduction and loss of the projecting rostellum, which prevents self-pollination in so many orchids. In some other foreign genera (*Phaius*, *Chysis*, etc.) the pollen-masses have no caudicles, and the rostellum is not developed ; the pollen-masses simply slip over the edge and fall into the cavity on to the stigmatic surfaces. It has been observed that these orchids set an abundance of seed ; just as our self-fertilising weeds do.

Of course several species of Sedges abound. There are two ferns (*Nephrodium Thelypteris* and *N. cristatum*) of the same genus as our great male fern. *N. Filix-mas* frequents the fens, as well as the quaint little fern the Adder's-tongue (*Ophioglossum vulgatum*).

The Sweet-gale or Bog-myrtle is an interesting little bog shrub. It only grows to two or three feet in height, bearing leaves two to three inches long. The flowers are in spikes, one-sexual, without any calyx or corolla. There is a variable number of stamens, adherent to the base

of a bract. The female consists of bracts with pistils, of two carpels, the fruit being a stony drupe. In some species it is covered with wax, which is utilised. This genus is the sole representative of the family, which, however, has species in Asia, South Africa, and North America.

The Crosswort (*Galium Cruciata* (Pl. XII.)) is not uncommon. It is one of the two yellow-flowered species, the other being *G. verum*, described as growing in poor pasture-land. The leaves of the Crosswort, or rather leaves and stipules, are in fours, and somewhat hairy.

There is always a conspicuous absence of Leguminous plants in marshes as in " Water-meadows " ; on the other hand, they abound in dry limestone regions, as in Malta, where they are the principal family of the herbaceous plants. A reason of this may be that if a clover or other leguminous plant be pulled up by the roots, they will be found to be covered with little nodules. These are made by the plant in response to the irritation set up by a parasitic fungus. These nodules are full of *bacteria,* called *Bacillus radicola.* This minute fungus finds its way into the roots through the absorbing root hairs. It then multiplies enormously, causing the plant to make the nodules to hold them, like oak galls for a grub. The fungus now lives upon the sugar and starch it finds in the plant. These foods consist of carbon and oxygen only, but no plant can live without nitrogen. This element is taken up by all ordinary plants from the soil, not as pure nitrogen from the air, but in compounds called nitrates ; and although the air consists of four parts nitrogen and one of oxygen, as a pure gas it cannot be utilised by green plants ; but the *Bacillus* has the extraordinary power of taking in the atmospheric nitrogen, provided it has the sugar, etc., at hand. This goes on for a time, but the fungus degenerates, and the host, in its turn, begins to get important nitrogenous food out of the decayed fungus ; this is an addition to what the leguminous plant acquires from

Lesser Celandine.

the soil. This remarkable phenomenon seems to account for the well-known fact that leguminous plants supply the most nourishing vegetable food we possess in the sense of flesh-formers, which require nitrogen. Thus while lentils, beans and peas average twenty-three per cent. of nitrogen and fifty-three per cent. of starch, potatoes, which are largely supplied with starch containing no nitrogen itself, have 1·2 per cent. of nitrogenous matters and eighteen per cent. of starch, with seventy-five per cent. of water.

RAMBLE VIII

IN THE WATER

THOUGH a good supply of water is essential to the well-being of all land plants, yet when their seeds happen to fall down close to the edges of a pond, etc., and the seedlings get more or less immersed, they can grow in adaptation to this excess of water, as was stated above in the case of the Bur-marigold (*Bidens*); but they can only do so by undergoing degradations in their structure. This is how certain species of land families of plants have become established as permanent aquatic plants.

The words "degradation" and "degeneration" may mislead, for in science they do not imply anything derogatory. They only signify that the plant ceases to develop certain parts necessary for an aërial existence, which are not required when the plant is more or less submerged, and so it does not develop them.

If the rambler examines several dicotyledonous plants growing in water, he will soon discover that a general feature is to have finely dissected, submerged leaves. For example, the Water Crowfoot (*Ranunculus heterophyllus* (Fig. 46)); the Water Milfoil (*Myriophyllum*); Mare's-tail (*Hippuris vulgaris* (Fig. 47)); the Hornwort (*Ceratophyllum demersum*); the Water Violet (*Hottonia palustris*); and some members of the umbellifers, etc.

What is the cause of this? Let us examine the Crowfoot, easily recognised by its small floating leaves and white-petalled flowers in the air. We shall often find

that a floating leaf will have a portion, as one-half or more, of it under water (observe the second leaf in the figure), and a portion floating. Wherever this is the case the part under water is dissected, but *not* the exposed part. From this one *assumes* that the *water is*, somehow, *the cause* of the blade being cut up into fine segments.

FIG. 46.—Water Crowfoot.

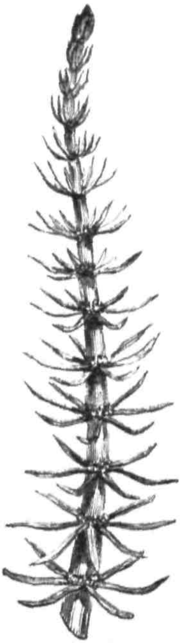


FIG. 47.—Mare's-tail.

Secondly, some water plants grow erect out of the water. When this is the case, the leaves produced on the aërial stem may be quite completely formed, while the lower ones submerged are dissected.

A botanist of the United States, Mr. McCallum, thought that the cause might be the saturation of the

living protoplasm rendering it too weak to complete the submerged leaves. To test this, he grew a plant of this kind (*Proserpinaca*) in water containing certain nutritive salts dissolved in it. This caused a lessening of the water within the stem, and at the same time imparted greater vigour. The result was that as the stem grew it now made perfectly formed leaves under water. Thus was the real cause *proved experimentally* to be the direct influence of the water in producing a "degradation" in the internal structure of the leaf.

The next point to notice is that this degraded condition of the leaf has become hereditary, and reappears when the seeds of the Water Crowfoot are naturally sown in the mud, when a pond dries up, or when sown in a garden border.

One variety or species is called *R. trichophyllus* (Fig. 48), for it has *no* floating leaves, being entirely submerged except the flowers. Sometimes it grows so thickly in a small pond that the branches get crowded out of the water into the air. When this is the case, a change of structure takes place at the water-level. The leaves in air—though retaining the dissected character—are adapted to live in air. The *visible* differences are seen in the little branchlets or segments of the leaves being shorter and stiffer. But under the microscope great changes are perceptible, for a skin or epidermis now appears with breathing pores called "stomates," both being absent in the submerged leaves.

We have a family of aquatic plants represented in England by three genera only. They are the Mare's-tail (*Hippuris vulgaris* (Fig. 47)), the Water Milfoil (*Myriophyllum*, three species), and the Water Starwort (*Callitriche*, two species). The family has only nine genera in all, one being the plant of the United States, which Mr. McCallum experimented upon (*Proserpinaca*). The Mare's-tail has narrow, ribbon-like leaves, the aërial ones being shorter and firmer than the submerged. In the

Milfoil, the leaves are finely divided as in the Water Crowfoot. The Water Starwort has floating leaves in a rosette, but the submerged ones are narrower and elongated. This little plant is very common and easily recognised.

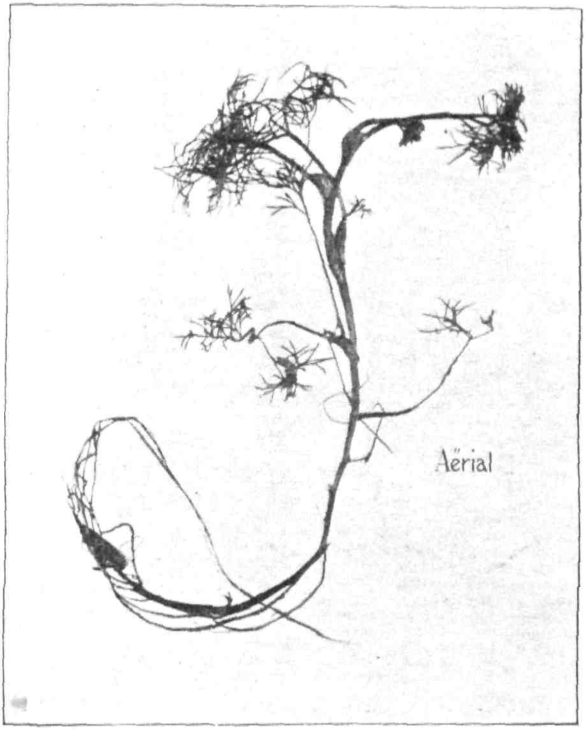


FIG. 48.—Hair-leaved Water Crowfoot.

In all these, the water has had a degenerating effect on the flowers as well as the foliage, for there is no corolla. In some the stamens are reduced in number, even to one, etc.

A common water plant is the Water-plantain (*Alisma plantago* (Fig. 49)). The parallel-veined, or rather "curvinerved," leaf, and the parts of the flowers in threes, or multiples of three, as well as the single cotyledon, proclaim it to be a Monocotyledon; but several features remind us of the details of the Buttercup family, pointing to the fact, as has been several times alluded to, that this class has descended from aquatic Dicotyledons. Let us see how the Water-plantain can suggest that interpretation.

FIG. 49.—Water-plantain.

The illustration well represents the character of the flowering stem, the form of the leaf and its "veins," as shown in outline. The flower has three green sepals, three pink or white petals. There are six stamens, not placed as usual in two whorls alternating in position, but two stand in front of each sepal, instead of one in the middle line of a sepal and the next between two sepals, *i.e.* in front of a petal. The interpretation of this unusual condition of things appears to be due to the fact that a honey-disk is found at the base of each sepal just where a stamen ought to be. These have, so to say, dislocated them. A somewhat similar thing has happened

in Geraniums. These have ten stamens, but while the *outer* five should be opposite, *i.e.* in front of the sepals, they are *within* the other whorl in consequence of a honey gland being developed on the receptacle immediately in front of it, so the stamen is, as it were, "pushed" inwards beyond the "truly" inner whorl.

Now, in other species of *Alisma* there are nine, twelve, or even more stamens, showing a previous condition of many stamens like those of the Buttercup family.

Then, again, there are numerous carpels, about twenty-four in all, arranged in a somewhat triangular manner. They are all quite free and distinct, having a single chamber and one ovule just as in the Buttercup.

Besides the dissected type of foliage, the ribbon-like form of leaf common among Monocotyledons occurs in a few aquatic Dicotyledons (Fig. 47). In the submerged *Lobelia* (*L. Dortmanna*), it will be found to have a rosette of narrow leaves two to three inches long. It sends up its flower-stalks into the air. It occurs in the lakes of Wales. We have only one other species of *Lobelia*, occurring in heaths in Dorset and Cornwall. It is a native of West France, Spain, and Madeira, and had a former land connection with the Continent.

The Shore-weed (*Littorella lacustris* (Fig. 50)) is another instance. It is a small plant of the plantain family found on the edges of sandy lakes, with very narrow ribbon-like leaves. It often forms a matted tuft under water. The figure shows the adventitious roots growing out of the stem, which is also sending out an offshoot. Apart from the flowers it has all the appearance of a Monocotyledon, as the primary root is obviously arrested.

Another common aquatic monocotyledon is the Arrow-head (*Sagittaria sagittifolia* (Fig. 51)), so called from the shape of the blade of the leaf, when it rises completely out of water and stands erect in the air, for it has at least two other forms.

When the plant is growing in deep water it has only the ribbon-like leaf. In shallow water it begins to form a blade at the end. At first this is oval, and floats.

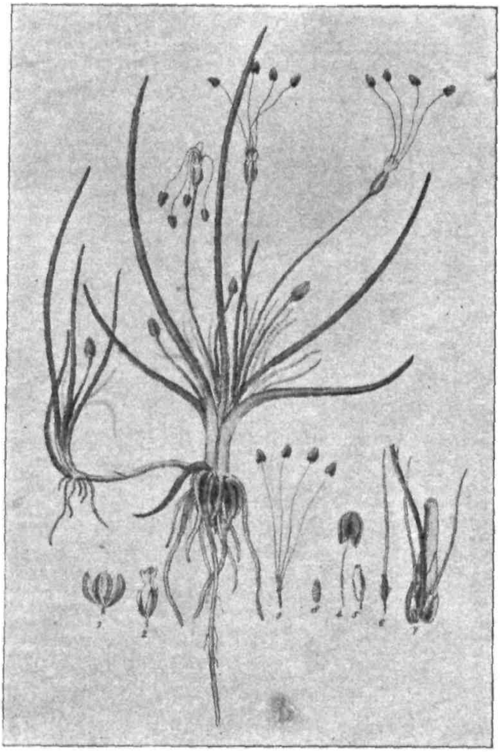


FIG. 50.—Shore-weed.

It next adds two downward projections at the bas making a blade like a spear-head. Lastly, the tw projections grow till the blade resembles an arrow-hea as shown in the figure.

Sallow Willow.

That the elongated type is simply due to being submerged entirely under water, is seen in the fact that if the blade be only half formed in air, *i.e.* spear-shaped, and the water be suddenly deepened, the tip of the spear-head will at once begin to elongate again. I have a specimen in which the two points at the base have elongated as well!

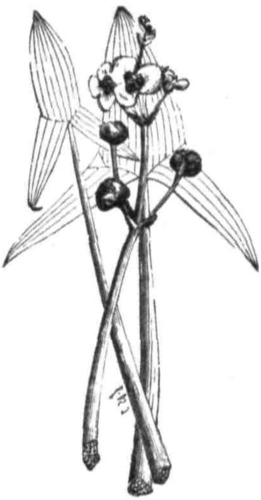


FIG. 51.—Arrow-head.

It is interesting to find that the leaves of Water-lilies, which are Dicotyledons, pass through the same three stages, but may add a fourth, for the subsequent leaves, *after* that with the arrow-head, are heart-shaped and float on the water; but in the Lotus they become peltate, that is, like a "shield."

The earliest leaves of the Lords and Ladies (*Arum maculatum* (Pl. VI.)), rising from a tuber in spring, have small, oval blades, but the larger, spotted leaves are arrow-headed. Such are reminiscences of the ancestral period when they were aquatic plants.

The more usual form of a monocotyledonous leaf is the primitive type of an elongated ribbon, as that of all grasses, sedges, flags, and all of our usual bulbous plants of the garden.

Monocotyledons are so called, as we have seen, because they, as a rule, have only one seed-leaf or "cotyledon," *monos* being the Greek for "single," and *di-* for two. Certain dicotyledonous, aquatic plants, as the European Water Chestnut, has only one; and the Lesser Celandine (Pl. XVI.), the earliest kind of buttercup to blossom, though now flourishing in damp soil, was undoubtedly

once an aquatic plant, and has only one cotyledon. Still, many of our aquatic dicotyledons have retained both. The fact that several Monocotyledons have two, one being more or less rudimentary, as in the Oat, seems to show that this is due to the loss of one through degeneracy by water.

As no Monocotyledon has a dissected *submerged* leaf like that of the Water Crowfoot and many other aquatic Dicotyledons, but always a long, narrow leaf, this seems suggestive of a very early separation from Dicotyledons, though the real origin is lost in the antiquity of past geological ages.

Let us examine the White Water-lily, and with a grapling iron pull up a piece of the rhizome or thick stem lying on the mud. Cut it across, and the "vascular bundles" are seen as dots scattered all through it, and not arranged in circles as are those of any terrestrial herb. As this is a common feature with all Monocotyledons, as may be seen in a stick of asparagus, it shows another effect of the water. The roots will be seen to come out of the surface of the stem in successive circles.

The flower teaches us something new. Unlike the buttercups, the numerous petals are *not* made out of the anthers,* but out of the filaments. In the middle, close to the pistil, are true stamens, with long filaments and anthers; but examining the flower from within outwards, we find the filaments broadening and the anther-cells diminishing, first one is wanting, then the other, and finally the filament is wide enough to be called a petal. This is another of Nature's ingenious ways of doing things!

I have mentioned that several families, though mostly terrestrial, have one or more genera aquatic, though not necessarily with submerged leaves. Thus, the Gentian family has five British genera, the Gentian itself having five species. Two genera, however, are water-plants, the Buck-bean (*Menyanthes trifoliata*) and the Limnanth

See note, p. 157.

(*Limnanthemum peltatum*). The first has trifoliate leaves and white flowers, slightly tinged with red and fringed within the corolla. The Limnanth has horse-hoof shaped leaves like those of the Water-lily, floating on the water. It also has rather large yellow flowers with five coherent petals, characteristic of Dicotyledons.

The Frogbit (*Hydrocharis Morsus-Ranæ*), a Monocotyledon, has leaves just like the last named; but the flower has only three white petals. The Water Soldier (*Stratiotes aloides*) of this same family has similar flowers, but the leaves grow in tufts submerged, each being sword-shaped, hence, probably, the name, while the margins are provided with small pointed teeth. It thus

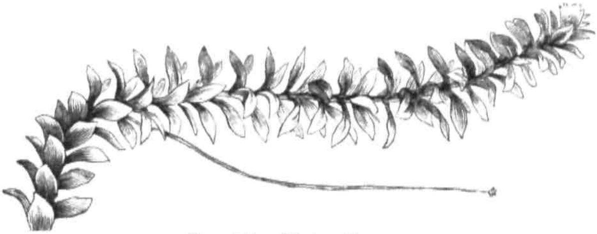


FIG. 52.—Water-thyme.

resembles in miniature, being only a few inches in height, the great terrestrial "American aloes" of cultivation.

As all Monocotyledons have descended from aquatic Dicotyledons, this type of leaf may have been the forerunner of the last-named plant.

A third plant of the same family is now included in our British flora, but it was accidentally introduced with timber about 1841 from Canada. It has been called Water-thyme (*Elodea canadensis* (Fig. 52)).

As the male plant has never come over, it is a good instance of vegetative multiplication, as the plant breaks up into joints and every one can strike root at the node where three or four leaves occur.

There are no less than twenty-one species of Pondweed in Great Britain, mostly entirely submerged, but some

FIG. 53.—Pondweed.

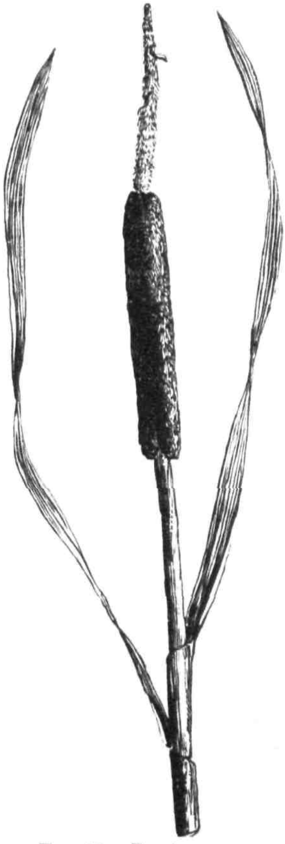


FIG. 54.—Reed-mace.

have floating leaves as well. The one figured is *Potamogeton crispus* (Fig. 53), so called from the crumpled appearance of the leaves.

Unlike other Monocotyledons, as a rule, the flowers have their whorls in fours instead of threes. There is no corolla, only four sepals, stamens, and carpels.

The pondweeds have no economic value, but one of

FIG. 55.—Common Reed.

the commonest with elliptical floating leaves (*P. natans*) is said to have farinaceous roots eaten in Siberia.

The Reed-mace, Cat's-tail or Club-rush (*Typha*), has two British species, *T. latifolia*, the broad-leafed (Fig. 54), and *T. angustifolia*, the narrow-leaved. The lower brown cylinder consists of female flowers. The upper yellow terminal one is composed of male flowers, consisting

of three almost hair-like sepals and three coherent stamens. A single carpel on an elongated long-haired stalk constitutes a single flower.

The first species has a larger head than the latter, with no barren interval between the female and male spikes, as in the latter.

When the pistil ripens into a dry achene, the hairs spread out, mutually thrusting the fruits out, making a great cloud-like mass if allowed to ripen indoors; but it is soon blown away by the wind. It is used for stuffing pillows, while the pollen is very inflammable and used in fireworks.

Of aquatic grasses there are two easily recognised, the Common Reed (*Phragmites communis* (Fig. 55)), which grows to some ten feet in height, bearing large, soft, and dense purple nodding panicles. The other has its leaves floating on the water, and is called Flote-grass, though Hooker names it Manna-grass (*Glyceria fluitans* (Fig. 56)).

We have three species of Bladder-wort (*Utricularia vulgaris* (Fig. 57)), inhabiting pools and ditches. It is carnivorous, for it is provided with little bladders, hence the Latin name *Utricularia,* from *utriculus.* This plant, like so many others with submerged leaves, has them finely dissected, upon the branches of which are the bladders. The following is Darwin's description of the bladders (abridged): "There are often two or three on the same leaf. They are supported on short footstalks. When fully grown, they are nearly one-tenth of an inch in length. They are translucent, of a green colour, and the walls are formed of two layers of cells. The bladders are filled with water, generally containing bubbles of air. They are rounded on one side and flattened on the other or lower side facing the stem. The dorsal or rounded side terminates at the rather pointed end in two long prolongations, formed of several rows of cells, containing chlorophyll and bearing six or seven long

pointed multicellular bristles. These prolongations of the bladder may be conveniently called the *antennæ,* for the whole bladder curiously resembles an entomostracan

FIG. 56.—Flote-grass

FIG. 57.—Bladder-wort.

crustacean, the short footstalk representing the tail. Beneath the two antennæ, the end of the bladder is slightly truncated; and here is situated the most important part of the whole structure, namely, the

entrance by the valve. On each side of the entrance from three to rarely seven long, multicellular bristles project outwards. These bristles, together with those borne by the antennæ, form a sort of hollow cone surrounding the entrance.

"The valve slopes into the cavity of the bladder. It is attached on all sides to the bladder excepting by its posterior margin, which is free, and forms one side of the slit-like orifice leading into the bladder. This margin is sharp, thin, and smooth, and rests on the edge of a rim or collar, which dips deeply into the bladder. The edge of the valve can thus open only inwards. The valve is colourless, highly transparent, flexible, and elastic.

"Two pairs of transparent pointed bristles arise from the near posterior margin. There are also on the surface of the valve numerous glands, which have the power of absorption. Those situated round the anterior margin of the valve are very numerous and crowded together; they consist of an oblong head on a long pedicel, formed of an elongated cell, surmounted by a short one.

"The internal structure of the bladder shows that it is covered with a serried mass of processes. Each of these consists of four divergent arms, whence their name of quadrified processes. They are composed of an extremely thin transparent membrane, so that they can be bent or doubled in any direction without being broken.

"The real use of the bladders is to capture small aquatic animals, and this they do on a large scale. I picked out five bladders which seemed very full, and found in them four, five, eight, and ten crustaceans, and in the fifth a single, much elongated larva.

"Animals enter the bladders by bending inwards the posterior free edge of the valve, which from being elastic shuts again instantly. As the edge is extremely thin, and fits closely against the edge of the collar, both projecting into the bladder, it would evidently be very

Cross-leaved Heath.
(*Erica Tetralix*.)

Dodder.
(*Cuscuta Epithymum*).

Plate xix., p. 155.

difficult for any animal to get out when once imprisoned; and apparently they never do escape."

With regard to the process of digestion of the prey, a remarkable difference exists between that of the Sundew and Butterwort and of *Utricularia*. Darwin observes: "From the analogy of *Pinguicula*, belonging to the same family, I naturally expected that the bladders would have digested their prey; but this is not the case, and there are no glands fitted for secreting the proper fluid. In most of the bladders the captured animals are so much decayed that they form a pale, brown pulpy mass. I have sometimes felt surprised at the small proportion of imprisoned animals in a fresh state compared with those utterly destroyed. Mrs. Treat * states with respect to larvæ that 'usually in less than two days after a large one was captured the fluid contents of the bladders began to assume a cloudy or muddy appearance, and often became so dense that the outline of the animal was lost to view.' This statement raises the suspicion that the bladders secrete some ferment hastening the process of decay. It is certain that matter is absorbed by the quadrified and bifid processes, . . . and we may confidently believe that protoplasm had been generated by the absorption of nitrogenous matter from decaying animals."

The above brief abstract seems to show that in the case of *Utricularia*, which frequents particularly "foul" ponds, the habit has been acquired of catching water animals, but not to utilise them at once. It is only after they have decayed—possibly the decay is hastened by a ferment—that they can extract nitrogenous matter wherewith to nourish and increase the quantity of living protoplasm within the plant.

The Water Violet (*Hottonia palustris*) has no relationship with violets, for it is a member of the Primrose family, but has become a submerged aquatic plant;

* *New York Tribune* (See *Gardener's Chronicle*, 1875, p. 303).

the leaves being finely dissected, as explained under the Water Crowfoot, as a consequence of the deteriorating action of water, preventing the plant producing completely formed leaves.

The flower resembles in shape that of a Primrose, but is lilac in colour, with a yellow centre. It is of two forms, as described under Cowslip; and sometimes it becomes cleistogamous, as happens with other aquatics when the buds do not rise above the surface of the water.

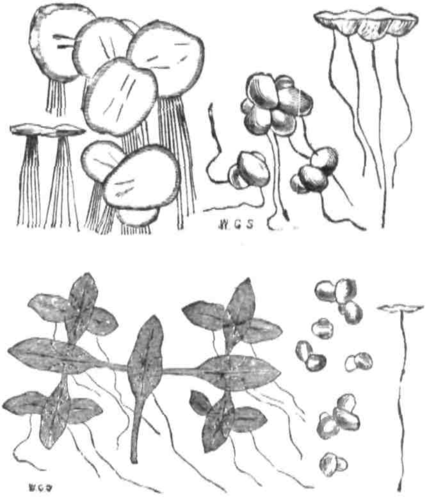
There are only two species; the other is in North America, and has curiously inflated internodes. In which of the two countries the ancestor originated is unknown.

I will conclude our brief study of aquatic vegetation with the smallest flowering plants in the world, the common Duckweeds (*Lemna*) of which we have four species, and one of a still smaller plant, in fact, the smallest of flowering plants known, *Wolffia arrhiza.*

Of the four Duckweeds (Figs. 58 and 59), which consist of little green masses, generally round, are a half, a third, and a quarter of an inch across. One having quite a different shape, as shown in Fig. 59, is about three-quarters of an inch long. There is no difference between stem and leaf, both being, so to say, fused into one common mass of cells. This is the case with seaweeds, called a "thallus." A thallus may have been the primeval condition of vegetable life, or—as in the Duckweed—a degeneration back again to a like structure. They have usually one, and the largest several, threadlike roots hanging down into the water, upon which the Duckweed floats. They can multiply "vegetatively" by budding at the sides, as shown in both the above figures, but also by seed. The flowers are within a two-lobed bract or "spathe," recalling that of the Lords and Ladies (*Arum maculatum* (Pl. VI.)). Within this are two stamens; but like those of the Spurges, they do not "blossom," *i.e.* come to maturity at the same time, for each represents

a male flower. A pistil with one ovule is also present, as a female flower.

With regard to *Wolffia*, which is only one-twentieth of an inch long, or no larger than a grain of sand! It is



FIGS. 58, 59.—*Duckweeds.*

rootless and has no spathe, the flowers bursting through the frond. The anthers are one-celled, and not like the Lemnas, which have two-celled anthers; so that it is even more degraded than the Duckweeds.

Note.—On p. 148, the origin of a petal of the buttercup is mentioned. In this flower, it is the anther-cells which are undeveloped, remaining open like little *honey-pots* (as in the Christmas Rose and Winter Aconite). In the Buttercup, the outer side of the anther is greatly enlarged and forms the petal; while the honey-pot is reduced to a tiny pit at the base; the little inner flap represents the inner side of the anther.

RAMBLE IX

ON HEATH-LAND

WE are all familiar with heaths and know the peaty soil covering sand and gravel on which only such plants grow as have become adapted to so poor a situation. It was said such plants were "sand-lovers," others "chalk-lovers," etc., but the fact is plants often grow very much better and form finer plants when away from their usual situations. Nevertheless, many have become so inured to one kind of soil, that they no longer can adapt themselves to another. Thus the broom will thrive well on good soil, but rhododendrons cannot stand chalk.

The first plants to attract our attention are, of course, the Heaths, of which we have five species. The two which abound are the cross-leaved (*Erica Tetralix* (Pl. XIX.)), with nodding pink flowers, and the Scotch heath (*E. cinerea*), though it is often the commonest in England. The other species figured (*E. ciliaris*) is only found in Cornwall and Dorset. The leaves have fine hairs on the margins, suggesting the name "ciliated heath," from the Latin *cilium*, an eye-lash. This and *E. vagans* (only found in Cornwall and Ireland) belong to the group whose continental home is West France, Spain, and Portugal.

The important points which characterise this genus is to have the parts of the floral whorls in fours, the stamens being in two whorls of four in each. The stamens are quite free and *not* attached to the corolla tube, a very exceptional condition with coherent corollas. The anthers

open by pores and not long slits, and are provided with little appendages.

In the cross-leaved heath, a honey-secreting ring surrounds the base of the ovary. The insect visiting the pendulous flower from below strikes the projecting stigma and deposits pollen from a previously visited flower. The eight anthers surround the style; their appendages reach to the corolla. The proboscis penetrating to the base dislocates these appendages, and a shower of pollen is shed upon the, now, sticky head of the insect, the gummy substance having come from the stigma first struck by the insect. This is chiefly a humble-bee. The hive-bee gets the honey by biting a hole in the corolla.

Another common heath-plant is known as Ling (*Calluna vulgaris* (Pl. XIX.)). It has smaller flowers than those of the heaths and tiny scale-like leaves. It is upon the young shoots of this that the grouse feed. The structure of the flower agrees with that of the heath, but it is slightly irregular in form. Moreover, the calyx is coloured. The hive-bee is its principal visitor.

The Harebell (*Campanula rotundifolia*) will represent the genus *Campanula*, a word meaning "little bell." It has a milky juice. The flower has an ovary invested by the receptacular tube, as the sepals, corolla, and stamens all arise from the summit. Hence the ovary is "inferior." The summit secretes honey, which is protected by the broad bases of the filaments which collectively form a cover concealing it. The style has numerous so-called "collecting hairs," because the anthers crowd round it and shed their pollen upon them. Then they shrivel and fall to the bottom. At this time only are the stigmas now ready to receive pollen with which a bee will have loaded its underside when searching for honey head-downwards, grasping the style by its legs. Though described as "round-leaved," it is only the basal leaves which are of that shape. On the flowering stem the leaves are very narrow and slender.

Another species of *Campanula*, occurring on similar soils, but more generally on roadsides, etc., is *C. Rapunculus*, known as Rampion. It is, however, doubtfully wild, as the fleshy root is edible and it has been cultivated as a kitchen vegetable. It has narrow leaves, with a light blue, bell-shaped corolla.

The Sheep's-bit (*Jasione montana*) is a not uncommon herb in heathy pastures, etc. It grows to eighteen inches in height. It bears heads with flowers of a lilac-blue colour. It belongs to the Campanula family, like the Harebell described above, and is, perhaps, a common flower on heaths, etc.

Another genus of the same family, the Ivy-leaved Campanula (*Wahlenbergia hederacea* (Pl. XXI.)), found in the damper, boggy ground, is a member of our special South-East group of plants found in the Western countries of Europe. It is a small plant, with slender stems and thin, heart-shaped leaves. The corolla is only half an inch across and pale blue in colour.

The Leguminous family is represented by the Furze (*Ulex europæus*), and in southern heaths, as about Bournemouth, the dwarf species (*U. nanus*), flowering in the autumn instead of the spring, is very common. The Needle-furze (*Genista anglica*) is not quite so abundant, though it occurs from north to south.

These three well illustrate a common feature of drought plants in being spinescent. It used to be thought that all such plants were thus purposely protected from browsing animals. If they are, so much is it to the advantage of the plant; but it is far from being true, as horses will eat furze, and camels the camel's "thorn-bush." Again, it was thought that the stings of nettles kept caterpillars off. On the other hand, numerous sorts live upon nettles! It seems to be forgotten by those who *assume* that such defensive structures are for the purpose suggested, that the whole of the animal world lives directly or indirectly upon the vegetable kingdom. One might as unreasonably

ask, why should the furze have spines with no juicy leaves, and grass be quite unprotected against cows?

Spinescence is solely the natural result of drought. As there are "Rain-forests" in the *wet* tropical regions, without a spine, so are there "Thorn-forests" in the *dry* tropical countries. It is the same in England: water gives luxuriance, drought prevents it; a luscious diet in one case, a wretched one in the other.

The Gorse, Whin, or Furze (*Ulex europæus*) has its branches reduced to spines, and the leaves are small, narrow, and sharp-pointed. If, however, it be raised from seed—and seedlings abound in heaths—it bears trifoliate leaves at first, proving that the usual spiny ones are simply the result of drought, as in the case of the Rest-harrow and many other plants, showing that they were formerly more "water-loving" than "sand-lovers"! A third spiny plant is the Needle-furze, but it belongs to the genus *Genista*, as also does the Dyer's Greenweed (Pl. VIII.), which has no spines.

The Broom (*Cytisus scoparius*), with its wealth of golden flowers, is very partial to dry, sandy districts. It has generally no leaves, the green stems undertaking their duties instead. If it grows in wet places, it can develop three-foliate leaves.

These four genera, Furze, Broom, Needle-furze, and Rest-harrow, differ from all other members of the pea-family in the British Isles in not having the uppermost stamen free, while the nine others are coherent. As the honey is secreted *within* this "staminal tube," the bee or other insect requires the top stamen to be detached so that it can thrust its proboscis inside.

In flowers without honey, as of the Broom and the three others, there is a curious way of "exploding" to expel the pollen. In the Broom the stigma lies in the midst of the five anthers of the longer stamens, and when a bee visits the flower those of the shorter explode and dispense their pollen on the bee pressing upon the closed

edges of the keel petal. "The shock is not enough to drive the bee away. . . . The split now quickly extends further, . . . when a second and much more violent explosion occurs." The style was horizontal with a flattened end below the stigma; but when freed from restraint it curls inwards, forming more than a complete spiral turn. It springs up and strikes the back of the bee with its stigma. The bee then gathers pollen with its mouth and legs.*

Several other genera have explosive powers, executed in different ways, as the Furze, the *Genista* (Pl. VIII., Fig. 17), Medics (*Medicago* sp.), etc.; but in all, they facilitate the disposal of the pollen, in such a way as to enable the bee to get dusted and convey it to another flower. It is easy to make the flowers explode with a fine pencil point if it be gently inserted down the middle line of the large upper petal or "standard" to the bottom. One of the best to illustrate it is the cultivated lucern (*Medicago sativa*).

Of small herbs, a little white-flowered Bed-straw (*Galium saxatile*) is common. It has its leaves in whorls and flower parts in fours.

The potentilla called Tormentil (*P. Tormentilla*) is equally common, bearing three to five foliate leaves, and small, yellow four-petalled flowers. Its root has long been employed for tanning, being excessively astringent.

A leafless parasite called Dodder (*Cuscuta Epithymum* (Pl. XIX.)) is very common on Furze bushes in heaths. It consists of stems and flowers only. The stems resemble yellow or red silken threads, for no part is green. It climbs like a tendril round the branches of the Furze, etc., thrusting suckers into them, and grafting itself to its host. So numerous are the stems that large patches may completely conceal the furze. The flowers are borne in globular clusters, about half an inch across, having minute tubular corollas with scales inside. It is an ally of the Bindweed (*Convolvulus* (Pl. XX.)) or of some other unknown plant of the same family.

* *The Fertilisation of Flowers*, by Prof. H. Müller, pp. 195, 196.

To show how similar acquired habits may occur in many plants, there is a parasitic plant of the same family as the familiar Bay-laurel tree of our gardens; which, like our Dodder, has no roots, but is called "Dodder-laurel," as the Latin name of the bay is *Laurus*. It climbs and adheres to bushes in the same way as the Dodder. In Australia they are called scrub-vines. One species grows at the Cape, but some species or other occurs in most hot countries.

A member of the Labiate family called Wood-sage (*Teucrium Scorodonia* (Pl. XIV.)) is equally common. It grows from a few inches to two feet in height, with oval leaves and flower stalks of about four or five inches long. The corolla is *not* hooded as in the Dead-nettle and others of the family, so the stamens and style stand erect and exposed. The anthers mature their pollen before the stigmas are ready to receive it. When it has been carried off by a bee, the filaments bend backwards so as to be out of the way, and the two stigmas are now ready to receive the pollen brought to them; so they come forward and take up the same position that the anthers had previously occupied. This process is by no means uncommon with flowers, especially those which are irregular.

FIG. 60.—Sheep's Sorrel.

One of the commonest of heath-plants is a little plant called the Sheep's Sorrel (*Rumex Acetosella* (Fig. 60)), allied to the Sorrel (*R. Acetosa*), and all the Docks, species of *Rumex*. It is rarely above a foot in height; the leaves are usually three-lobed or spear-head shaped. The male and female flowers are on separate plants.

Squinancy wort
Wild Thyme

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One or two small and creeping species of Willow may be found, such as *Salix repens*, with silvery leaves when young. Another, *S. aurita*, forms a small bush two to four feet.

Certain grasses are very characteristic of dry heaths; one known as *Aira flexuosa*, growing from one to one and a half feet high, has narrow leaves rolled inwards on the edge, to protect the surface from the effects of drought. The panicle or clusters of florets are only two to three inches long.

Another called the purple *Molinia* grows both in wet and dry places. It forms large tufts, and bears green or purplish contracted panicles.

Ferns, as a rule, prefer more moisture than is to be found in dry heath-land; but one, the Common Bracken (*Pteris aquilina*), is abundant in many heathy places, as under the pines at Bournemouth, as well as in dry pastures and parks. Yet, if this happens to grow in a moist place, it will mount above tall shrubs having their fronds several feet in height.

Two little plants are figured on Pl. XX., the Common Thyme (*Thymus Serpyllum*) and the Squinancy-Wort (*Asperula cynanchica*). They both frequent dry places, but are not found *among* the heath. The latter is our only ally of the Woodruff; while the former belongs to the Labiate family. The flowers are degraded from the form of the Dead-nettle, as the figure will show. They are minute and clustered, so that bees crawl over several. The anthers spread out so as to dust the bees anywhere (Fig. 61). The reader should compare this with Pl. V.

Fig. 61.—Flower of Thyme.

Species of the Cow-wheat has been described elsewhere as being more or less parasitic; there is another species (*Melampyrum pratense*) which is found in heaths as well as pastures. The leaves are lanceolate in shape.

The bracts under the flowers are toothed or much cut, sometimes spear-shaped. The corolla is tubular, stands horizontally, and is pale yellow. It may be also a parasite.

Our finest Gentian (*Gentiana Pneumonanthe*) occurs in moist places on heaths, as near Swanage. The stem can grow to two feet in height, bearing flowers one to two inches long, the corolla being bright blue within.

A species of St. John's Wort (*Hypericum pulchrum*) may be found in heaths as well as elsewhere. It grows from one to two feet. The leaves have pellucid glands (like the "perforated" species). The flowers are small, less than an inch across the petals, are yellow tinged with red, having black glands on the margins.

RAMBLE X

By Bogs, on Fenlands and Moors

Marshy places and bogs often accompany heaths and moors. The first plant one observes in them is the quantity of Bog-moss (*Sphagnum* (Fig. 62)). It is of a peculiar kind, being much paler in colour than ordinary green mosses. This is due to the fact that it is mostly made up of large empty cells with round holes. The green cells are small and connected into a sort of network around the larger ones. These colourless cells act as a sort of siphon, for the water rising from below is conveyed away above; so that the bog-moss is always like a sponge full of water.

Fig. 62.—Bog-moss.

It is in this moss that the little Sundew (*Drosera*, Pl. XXI. (Fig. 63)) grows. It has very feeble, imperfectly formed roots, and so instead of trusting to them to supply nourishment, it has adapted itself to catch and devour insects.

The commonest of our three species is the round-leaved (*D. rotundifolia*); the round blades are furnished

with what Darwin called "tentacles," long ones round the margin and shorter ones on the blade. Each consists of a cellular stalk with a roundish head which secretes at first a drop of gum, so that when a fly alights on the tentacles of the blade, it cannot escape. In a short time

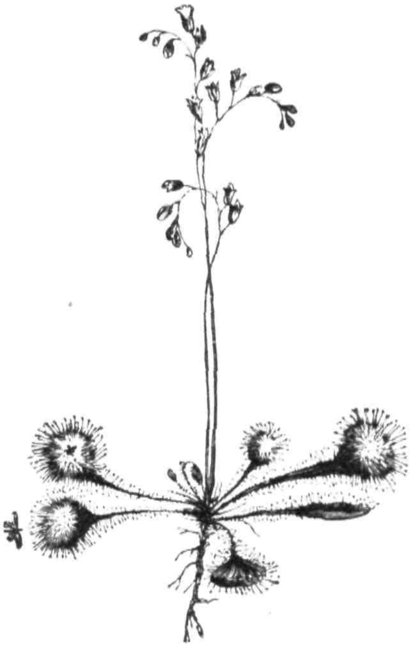


FIG. 63.—Sundew.

the longer ones bend inwards and place their heads upon the fly; so it is imprisoned between the tentacles above and below.

These glandular heads now begin to secrete a digestive fluid, which dissolves all that can be absorbed from the fly. They subsequently spread out to their former position,

leaving the relics of the fly. It has been discovered by Sir Francis Darwin, by experiments, that the chief use of the insectivorous habit is to enable the plant to increase the quantity of seed.

Pl. XXI. shows a complete plant of the natural size, while Fig. 64 is the blade of a leaf magnified to show the lengths of the tentacles, how they are reduced from the circumference to the centre. A fly is represented as having settled on the right-hand side; the longer tentacles near

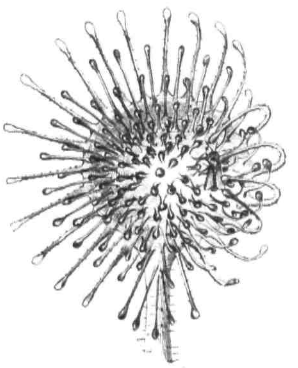


FIG. 64.—Leaf-blade of Sundew.

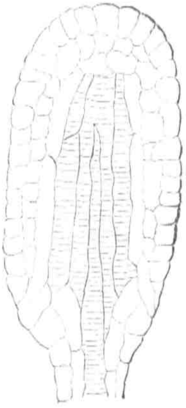


FIG. 65.—Head of a Tentacle of Sundew.

it have already bent themselves down over it, as if they knew the exact spot where the fly is located. If the fly had been in the middle of the blade, then *all* the circumferential tentacles would have come down upon it.

Fig. 65 is the head of a tentacle. It is composed of cells with a medial cluster of elongated cylindrical cells, each having a spiral fibre within it. The cells contain a uniformly red fluid. When, however, the head is upon a fly, and is secreting the digestive fluid, which dissolves the nitrogenous matters of the softer parts of the fly, then

a visible change is soon seen in the tentacles. From having been uniformly red, they look paler in tint. Under a microscope this is seen to be due to a sort of "clotting;" the colour appears like drops in a colourless fluid, so the *whole* of each cell is no longer red. This process begins with the head and goes on stage by stage, till it gets to the bottom of the tentacle. After a time, when all nourishment is extracted from the fly, the cells again become entirely red, this time from below upwards.

Darwin made numerous experiments, using a great variety of *inorganic* substances as well as *organic*; placing the tiniest fragments of glass, etc., as well as threads on the *outer* glands. These at once proceeded to carry them to the middle of the leaf, as if to let other glands have a share in the prey. He says, for example: "I made many trials with such things as splinters of white and blue glass, particles of cork, minute bits of gold-leaf, etc. In one case $\frac{6}{7}$ of the particles placed on separate glands were carried towards the centre of the blade. . . . I was so surprised at the smallness of the particles which caused the tentacles to become greatly inflected, that it seemed worth while carefully to ascertain how minute a particle would plainly act. . . . A bit of blotting-paper weighing $\frac{1}{465}$ of a grain was placed on three glands, and all slowly curved inwards; so that each of the three had only $\frac{1}{1395}$ of a grain. A piece of cotton-thread $\frac{1}{50}$ of an inch, weighed $\frac{1}{8197}$ of a grain. The tentacle was considerably inflected in 1 hr. 30 m.; and the bit of thread was carried to the centre in 1 hr. 40 m. Again, two particles of the thinner end of a woman's hair (one of these being $\frac{18}{1000}$ of an inch in length, and weighing $\frac{1}{35714}$ of a grain, the other $\frac{19}{1000}$ of an inch in length, and weighing of course a little more) were placed on two glands on opposite sides of the same leaf, and these two tentacles were inflected halfway towards the centre in 1 hr. 10 m."

It should be noted that the digestive fluid is *only* secreted when *digestible* substances are present. Though

inorganic substances cause inflection of the tentacles, no secretion is wasted upon them.

The Sundew bears small self-fertilising flowers, producing capsules full of seeds.

Another species, *D. intermedia*, has obovate but rather narrow leaves, the blade being gradually contracted into the stalk. It is the common species in the New Forest; the third, *D. anglica*, is similar to the last but larger.

The reader should study Darwin's work on *Insectivorous Plants* for a full description of his experiments with *Drosera*, especially on *D. rotundifolia*.

Another insectivorous plant is the common Butterwort (*Pinguicula vulgaris*). It occurs more in the West of England and Scotland. It has a rosette of oval pale or yellowish-green leaves lying on the ground; they are thick and covered with stalked, glandular hairs. These glands, of a button-like shape when magnified, are insectivorous; but instead of their stems curving over a fly as of the Sundew, the margins of the leaf curve over it, so that the prey rests on glands below, and those on the edge of the leaf come down upon it (Fig. 66).

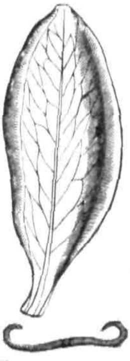


FIG. 66.—Leaf of Butterwort.

It bears a flower resembling a violet in shape and colour, but it is of a quite different construction. The only other genus of the same family in the British Isles is the Bladderwort, which is submerged in the water of pools and ditches, described elsewhere.

The insectivorous habit of the Butterwort has been elaborately described by Darwin, to whose work the reader is referred; but a brief epitome of his observations may be given here.

He found that two causes made the margins of the blade of the leaf to curl inwards, viz. a "slight continued pressure and the absorption of nitrogenous matter. . . . The shortest time in which a plainly-marked movement

Cotton Sedge.
Lesser Skull-ca
Round leaved Sundew.
Bog Asphodel.
Bog Pimpernel.
Bog Campanula.
(Campanula hederacea).

was observed was two hours and seventeen minutes. After a leaf has become well incurved and has again expanded, it will not soon answer to a fresh stimulus." Fig. 66 shows a leaf with the margin incurved; but stalked glands are not represented. This figure would apply to both the species, the above and *P. lusitanica.*

By means of this incurving "the glands of the overlapping margin are thus brought into contact with objects and pour forth their secretion, afterwards absorbing the digested matter."

When the leaves are washed by rain, many objects in the middle would be lost, but it was found that the curled-up edges caught and retained the prey.

"When a number of glands have been powerfully excited by bits of meat, or any other stimulus, the secretion often trickles down the leaf and is caught by the incurved edges, instead of rolling off and being lost. Moreover, the secretion often collects in little pools within the channel, or in the spoon-like tip of the leaves; and I ascertained that bits of albumen, fibrin, and gluten are here dissolved more quickly and completely than on the surface of the leaf, where the secretion cannot accumulate."

FIG. 67.—The Pale Butterwort.

A smaller species called the Pale Butterwort, *P. lusitanica* (Fig. 67), occurs in moist places, but is somewhat local in the South-West of England, from Hants. to Cornwall. It is to be found in the heaths near Swanage. The corolla is pale lilac and very small. It is a native of France, Spain, and Portugal, and is one of the little group of plants which has crossed before the Channel existed.

With regard to *P. lusitanica*, Darwin observes: "The leaves are rather smaller, much more transparent, and are marked with purple veins. The margins of the leaves are much more involuted. The glands differ from the preceding in being purple. The leaves catch many small insects, which are found chiefly beneath the involuted margins, probably washed there by the rain. The colour of the glands on which insects have long lain is changed, being either brownish or pale purple, with their contents coarsely granular; so that they evidently absorb matter from their prey.

FIG. 68.—Grass of Parnassus.

The white-flowered Grass of Parnassus (Fig. 68) is not uncommon in bogs and moist places. It has a tuft of leaves, oval and pointed, and single-flowered stems, six inches to a foot high. The flower has five white petals with five stamens. In addition, there are five curious structures like the palm of a hand with about twelve fingers or rays, each capped by a glossy yellow ball, but it does not appear to be either sticky with gum or honey. The anthers are brought down upon the pistil, one by one

in succession; and while there the anther cells discharge their pollen. The filament then bends outwards and allows another to take its place. It is not until all five stamens have done this, that the stigma is developed and receptive for pollen; so that the flowers *must* be pollinated from another flower.

These curious structures, alternating in position with the five stamens, bear two shallow depressions on the "palm" which secrete honey, so that the yellow knobs on the tips of the "fingers," though perfectly dry, may indicate to the insect where to find the honey. Indeed, a fly has been observed licking the knobs, being deceived by their appearance!

A species of St. John's-wort (*Hypericum elodes*) is found in bogs over the western part of England, and in the New Forest. Our other St. John's-worts are smooth-leaved plants with opposite leaves and bearing, as a rule, clusters of golden-yellow flowers. The reader will know the large-flowered hypericum of our gardens, forming masses of foliage on the ground or the borders of shrubberies, the flower being three or four inches across, with innumerable stamens. On a close inspection, these will be found united in separate clusters; usually three, but the large flowered kind has five bundles.

The Heath family (*Ericaceæ*) has five British Tribes. The first is called *Vaccinieæ*, containing in these islands one genus *Vaccinium*. It includes shrubby plants with usually evergreen leaves. Our four species are (1) the Whortleberry, Bilberry, or Blaeberry, for it is known by all three names (*V. Myrtillus*); (2) *V. uliginosum* has no English name; (3) The Cowberry (*V. Vitis-Idæa*); (4) The Cranberry (*V. Oxycoccus*).

The first is generally diffused and extends to Shetland. It has rosy red, small flowers and dark blue berries often used for preserves, etc.

The second is a mountain bog plant. It has pale pink

flowers, the berry being like that of the Whortleberry but smaller.

The third is chiefly mountainous, though found in South Wales and Devon. It has trailing branches, with leathery box-like leaves, and bears red berries.

The fourth extends from Somerset to Shetland. It occurs in peat bogs. It has red flowers; the stamens have purple, hairy filaments and yellow anthers. The berry is dark red.

With regard to the fruit of these species of *Vaccinium*, the berries of the Bilberry are everywhere eaten where they grow. They were formerly brought to London, but since the Cranberry was introduced from the Baltic, they are not now sold there. A jelly used to be made from them. The black grouse are said to eat it.

The fruit of the second species is somewhat larger than that of the Bilberry. In Siberia they are said to be distilled to make an intoxicating drink.

The leaves, which are without the toothed edge of the Bilberry and deciduous, are used in Iceland with the shoots of the Alpine Club-moss for dyeing woollen cloth yellow.

The Cowberry is not confined to mountains, but is found in England and Wales. It is a low evergreen shrub, six to ten inches high.

The berries of the Cowberry are not so much eaten as the Bilberry, but they are collected in Bothnia and sent to Stockholm; but they are inferior to Cranberries, with which they are sometimes mixed for sale in London. In Siberia they are kept in water through the winter and eaten in spring, forming an agreeable and wholesome article of fruit in that season.

A small shrub of the same, the Heath, family, named *Andromeda polifolia*, is found in peat bogs in Wales and elsewhere. It has a long stem, rooting at the base, with somewhat erect branches. The flowers droop with purplish corollas. It has capsules.

A somewhat similar little plant is found in boggy heaths in Connemara and Mayo in Ireland. St. Dabeoc's Heath (*Dabeocia polifolia*). The flowers droop with crimson, purple, or white corollas. It is found in West France, Spain, Portugal and the Azores; all these lands having once been continental.

In some moors and bogs of our mountainous regions several other plants occur which our Scottish ramblers may have a chance of finding.

The Bird's-eye Primrose (*Primula farinosa*) is a peculiar species, the leaves having a mealy appearance below, or sulphur-coloured. The flower-stalk is from two to eight inches high, with rather small flowers, about half an inch across, the corolla being of a lilac colour with a yellow base. It is "heterostyled," as Darwin calls those species which have long and short styles with stamens to match, as described elsewhere.

On the other hand, a very similar plant, but smaller (*P. scotica*), occurring in Orkney, Caithness, and Sutherland, would seem to be only a more "arctic" form, and *not* heterostyled but self-fertilising.

The Bog Pimpernel and the Bog Campanula are both represented on Plate XXI. The former is an ally of the poor-man's weather-glass, also called the Scarlet Pimpernel, of the Primrose family.

The Campanula (*C. hederacea*) and the Bog Pimpernel (*Anagallis tenella*), both on Pl. XXI., are not infrequent.

The fens of the Eastern counties are of course typical bog land, and abound with varieties. The following have been enumerated in the Wicken Fen, situated about seven miles south-east of Ely—The Fen Orchis, the Marsh Helleborine, the Fen Violet, the Fen Pea, the Marsh Fern, Marsh Parsley, the Lesser Bladder-wort, etc.

A pretty little plant, the Bog Asphodel (*Narthecium ossifragum* (Pl. XXI.)), is a bog plant, sometimes called the Lancashire Bog Asphodel, as it is more characteristic of the north, though found in many counties of England.

It has a raceme of about three inches long, with yellow, pointed perianth-leaves. The filaments are woolly, but the anthers are of a deep orange colour. The leaves are grass-like; it belongs to the Lily family. It has been placed in the Rush family, for it resembles a rush, but the yellow flower has determined its final position.

An interesting little shrublet, known as the Sweet-gale (called *Myrica Gale* in Latin), will be found in bogs and wet moors. It bears male and female catkins along the ends of the branches; the male consists of a scale with four stamens, and the female one with two carpels. It has thirty-five species scattered all over the world, excepting Australia, in the temperate regions.

When a single genus represents a family, as in this case, and in Horsetails (*Equisetum*), it means that there has been a long-lost ancestry, one kind only having survived. Thus in the Northern hemisphere, *Myrica* is found in West and North-West Europe; North Asia, China and Japan, and North America. To this may be added Java and Cape Colony. Lastly, it is found as an extinct species in fossil plants of Switzerland.

The Sweet-gale is also called Bog-myrtle, from the scent of the leaves, which were formerly used for scenting clothes.

Another unique genus, and with only one species, is found in bogs from Devon and Kent to Sutherland, but is rare, and being very small is probably often overlooked. It is the Bog-orchis (*Malaxis paludosa*). It is a European plant of the colder parts. Darwin has described the peculiarities of the flowers in their adaptation to pollination by insects.* It also propagates itself by little offshoots from the leaves, as already described in the Lady's Smock and certain Ferns. Some members of the Sedum family having thick, fleshy leaves do the same thing; such as a rare species of Stone-crop called *Sedum dasyphyllum*, an introduced species, occasionally found in old walls and rocks.

* *Fertilisation of Orchids*, p. 130.

Another orchid of bogs is *Liparis Loeselii*, usually two-leaved. It is only found in the Eastern counties, as Norfolk, Suffolk, Hunts, and Cambridge. The flowers are about half an inch across, of a pale yellow-green colour.

One species of Lady's Tresses, *Spiranthes æstivalis*, is found in bogs, the other, *S. autumnalis*, in dry pastures; the flowers are arranged in a spiral round the stem, hence the name, and are very scented.

The Coral-root (mentioned elsewhere as a saprophyte) grows in boggy or sandy woods in East Scotland, but is very rare. It is six to ten inches in height, with red-brown scales instead of leaves; the sepals are olive-green, and the petals whitish with purple tubercles.

Rushes, which as a rule are tenacious of moisture, have representations, especially in alpine bogs; such as *Juncus triglumis*, *J. biglumis*, *J. castaneus*, and *J. trifidus*. The leaves are compressed or channelled and bear few flowers (one to three).

Another, very variable, also occurs in mountain bogs, but has many flowers, the leaves being flat, and chiefly from the ground. It is *J. articulatus*.

Sedges may of course be expected in bogs; there are, for example, four genera, very characteristic. The Latin names are *Rhynchospora alba* and *R. fusca; Schœnus nigricans; Cladium Mariscus*, and *Kobresia caricina;* as well as some species of *Carex*. It would, however, require minute technicalities to explain them; so that we must leave it to the rambler to find their descriptions in a flora.*

We will, however, try to describe the very conspicuous Cotton-sedge, *Eriophorum*, with its large tuft of white, silky hairs when in fruit. It is common everywhere, but especially in elevated moor-land.

There are three species of Cotton-sedge (Pl. XXII.), often wrongly called Cotton-grass, as it is one of the Sedge

* Such as John's *Flowers of the Field* (S.P.C.K.), or Hooker's or Bentham's *British Floras*.

—and not the Grass—family. It can be at once detected when the grains are ripening by the tuft of silky hairs which the stems bear. These hairs were quite short in the flowering stage, surrounding the stamens and pistil. They probably represent a lost perianth; just as the "down" of a thistle or dandelion stands in the place of the calyx of composites. The flower consists of a chaff-scale, within which are the hairs, three stamens, and a pistil of three carpels. The long hair cannot be woven, being too brittle, but has been used for stuffing cushions.

Besides the Horse-tails (*Equisetum*) there are two other flowerless plants characteristic of certain boggy regions, the Royal Fern (*Osmunda regalis*), and a small creeping Club-moss (*Lycopodium inundatum*). The former is the largest fern we have, the fronds sometimes being six or more feet in length. The spore-bearing stem, having rarely or no foliaceous parts, has suggested the erroneous title," flowering fern."

Though our Club-mosses are all small creeping herbs, they represent to-day some of the tallest trees of the coal-epoch.

Mr. W. G. Smith distinguishes between the marshes and bogs in Scotland, giving as illustrations those of Forfar and Fife. He says there are "Two extreme types, the marsh and the bog, and between them there is every stage of transition. The typical bog prevails in the heather area, and the vegetation consists of peat-forming and peat-frequenting plants. Mosses (*e.g. Sphagnum, Polytrichum* and *Aulacomnium*) play an important part in the early stages of the formation of a bog. The flowering plants include, of the Heath family, Ling, heath, species of *Vaccinium*, of Sedges, *Eriophorum, Eleocharis, Scirpus* and smaller species of *carex:* of Grasses (*Molinia* and *Nardus*), the Crowberry (*Empetrum*), Bog Myrtle (*Myrica*), Butterwort (*Pinguicula*), Sundews (*Drosera*), Bog Asphodel (*Narthecium*), etc.

"The marsh vegetation includes the taller species of

Bee Ophrys.

(*Ophrys apifera*)

(III. p. 172.)

Sedges, Rushes and Grasses, with other plants, such as Marsh Marigold (*Caltha palustris*), Cuckoo flower (*Cardamine pratensis*), Ragged Robin (*Lychnis Flos-cuculi*), Meadow-sweet (*Spiræa Ulmaria*), Willow-herbs (*Epilobium hirsutum* and *E. palustre*), Dropworts (*Œnanthe fistulosa* and *Œ. crocata*), Marsh Bedstraw (*Galium palustre*), Marsh Ragwort (*Senecio aquatica*), Forget-me-nots (*Myosotis cœspitosa* and *M. repens*), Marsh Docks (*Rumex conglomeratus*, *R. domesticus ; Polygonum amphibium* and *P. Hydropiper*), Marsh Orchids (*Epipactis latifolia* and *Orchis latifolia*), Willows (*Salix*) and Alder (*Alnus*).

"A comparison of these representative plants shows that the bog plants are generally slow in growth and low in stature, whereas the marsh plants grow rapidly and either attain a considerable height, or, if low, produce many leaves and shoots in a single season. In other words, while the annual increment of plant material on the marsh is large, in the bog it is small.

"It has been suggested that 'the fundamental distinction is that the marsh vegetation grows in water, which is richer in food materials, especially lime, and the peaty matter formed contains a muddy deposit, and yields a large percentage of ash ; whereas in the bog, the water is poor in lime and other mineral acids, while the peat is almost entirely made up of plant remains and yields little ash.'

"The contrast between the vegetation of the marsh and that of bog is another instance which runs throughout all the papers dealing with botanical survey. Especially striking is the contrast between lowland loch and highland loch, grassy moor and heather moor, oak wood and pine wood. The pine wood, heather moor, highland loch, and the bog represent vegetation with a meagre supply of food ; either because the soil is poor or because peat has accumulated over a richer soil." *

* The rambler who is interested in this subject should study *Types of British Vegetation*, edited by A. G. Tausley (Cambridge University Press).

RAMBLE XI

In Chalk and Limestone Regions

The conditions mentioned in the title of this ramble account for a number of plants, which are either confined within or are to be found especially in calcareous districts; and as our ramblers live in every county, many may have the opportunity of studying such plants, of which I will only speak of the more prominent ones.

The Cheddar Pink (*Dianthus cæsius*) may be *seen;* but it is said to have been all taken except such plants as are now inaccessible! The petals are rose-coloured, about one inch across. It is a native of Belgium.

The perennial Flax (*Linum perenne*) is very rare, occurring from Durham to Essex. It was tolerably plentiful in one place near Cambridge in 1855. It grows about one to two feet high, has narrow leaves and bright blue flowers one inch in diameter. It is a native of mid-Europe.

Darwin studied several species of *Linum*, and found some were like the primrose, the flowers having two forms of stamens and pistil. His object was to test the relative degrees of fertility of the long and short-styled pistils. *L. perenne* is thus "dimorphic"; "of the flowers on the long-styled plants, twelve were fertilised with their own form pollen, but from a different plant; not one set a seed capsule, but when pollinated correctly from the anthers of the same height as the stigmas they set plenty of seed." So that Darwin concluded: "We have the

clearest evidence that the stigmas of each form require for full fertility that pollen from the stamens of a corresponding height, belonging to the opposite form, should be brought to them." *

L. usitatissimum (Fig. 69), the Flax plant of commerce,

FIG. 69.—Flax.

is perfectly self-fertile, as the stamens and styles are of the same length.

Some years ago, the perennial flax was recommended for cultivation as a fibre-plant, but it was never adopted, as the fibre was found to be coarser and the seeds, "linseed," smaller than those of the true flax, which is occasionally found wild, having escaped from cultivation, in the

* *Forms of Flowers*, p. 92.

Eastern counties. It is the inner fibre of the stems which constitutes thread when properly treated, *i.e.* "heckled" and first turned into tow, then spun into yarn.

In the plagues of Egypt it is said that the flax was "bolled." This means in "flower," not when in fruit, which a is dry and globular capsule, containing ten shiny brown seeds called "linseed," full of oil, as nourishment for the embryo within.

The difference between flax and cotton is easily seen under a microscope; for while flax-fibres are long, cylindrical, thick-walled and tapering to a point at each end, cotton is only composed of hairs on the seeds, and each, when dry, becomes flat and twisted.

The cotton plant belongs to the Mallow family, and bears large yellow flowers, and pods full of seeds covered with a dense clothing of white hair.

Linen cloth made from flax was the only kind known in ancient Egypt, cotton being unknown in the earlier dynasties; all "mummy cloth" is linen. Fine linen is often mentioned in the Scriptures. Excessively fine linen is mentioned by Pliny, who speaks of a vest of King Amasis of Egypt (B.C. 572), each thread of which was made up of 365 finer ones.

It was customary to dye linen of a purple colour; and Pliny alludes to the dyeing of sails as a "frivolous" if not "mad" practice. He has a long but somewhat amusing paragraph about man's audacity in trusting himself to the sea, in allusion to the linen sails of ships. He writes: "What department is there to be found of active life in which flax is not employed? And in what production of the earth are there greater marvels to us than in this? To think that here is a plant which brings Egypt to close proximity to Italy!—so much so, in fact, that Galerius and Balbillus, both of them prefects of Egypt, made the passage to Alexandria from the straits of Sicily, the one in six days, the other in five! . . . What audacity in man! What criminal perverseness! Thus

to sow a thing in the ground for the purpose of catching the winds and tempests, it being not enough for him, forsooth, to be borne upon the waves alone!"

The purple-flowered Pasque-flower (*Anemone Pulsatilla*) is only found on chalk hills and limestone pastures. The much dissected leaves are developed after the flowers. These consist of six coloured sepals, with no true petals, but the outer stamens have knob-like processes which secrete honey instead of bearing anthers with pollen.

There are numerous stamens and carpels; the latter become achenes with long feathery tails (styles).

We have two British species of Hellebore (*Helleborus fœtidus* (Fig. 70)), the Stinking, also called Bear's-foot or Setterwort, and *H. viridis*, the Green Hellebore. Both occur in the chalk districts of the East of England, as also in Holland and Belgium, whence they doubtless came. They are evergreen bushy herbs with peculiar-shaped leaves divided like fingers. Hence, perhaps, arose the name Bear's-foot. They have green flowers consisting of a calyx; there are no petals, but in their place are little tubular honey-pots as described in the case of other genera of the Buttercup family. The Christmas Rose (*H. niger*) of our gardens is a foreign species with a white or reddish calyx. (See *Note*, p. 157.)

FIG. 70.—Fœtid Hellebore.

They are both dangerously poisonous, though previously used in medicine; but as deaths have occurred, they are now discarded.

Insanity was attributed to the use of Hellebore by the ancients.

Hooker describes three species of Mignonette as

growing in the British Isles, viz. *Reseda Luteola*, the Dyer's Weed or Weld, *R. lutea*, and *R. alba*, introduced, as this is a common South European weed, as in Malta. The origin of the garden mignonette is unknown. It most nearly resembles a form of *R. alba*, but this, like our native species, have no scent. As the commonly cultivated species is easily obtained, the structure of the flower will illustrate that of the wild plants in being precisely the same in all essential features. There is a calyx of six separate sepals, a corolla of five small-fringed petals of different sizes. The smaller have fewer appendages, two or three, or even one as in our wild species. A curious one-sided honey-disk lies between the petals and the numerous stamens. The pistil consists of three coherent carpels, shown by the short stigmas. The ovules are in three rows on the wall of the one-celled ovary.

The Viper's Bugloss (*Echium vulgare*) grows in many places, as in chalky hills, waste ground, etc. It is common about Cambridge and called by the country-folk Cat's-tail. It belongs to the Borage family, characterised by rough foliage, with bristly hairs; hence the family was named by earlier botanists *asperifoliæ*. So rough and stiff are the almost prickly hairs, that Professor Martyn of Cambridge observed that when bees come for honey they are apt to get their wings torn. He adds that "agriculturalists remarked that it appears plentiful every third year, when the fields are quite blue with its flowers." The term "viper's" arose from the idea that resemblances in plants were an index to their medicinal virtues; so the spotted leaf of the lungwort, it was thought, must be good with one affected in the lungs. The curled flower-stalk of the Forget-me-not gave it the name of "scorpion-grass"; so it would probably cure a scorpion's sting!

A species of Speedwell (*Veronica spicata*), a form of which has long been cultivated, with the flowers in rather dense spikes, is found in chalky pastures of East Anglia and on limestone rocks in the West of England and Wales,

as at Barmouth. The flowers of Speedwells are exceptional, the petals being only four and the stamens two. The latter are spread out, the pistil lying between them. When a fly wants to settle to get the honey, it drags the two stamens together and then rests upon them together with the style, as shown in Fig. 71, of the common bright blue-flowered Germander Speedwell (*V. Chamædrys*).

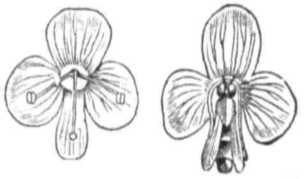


FIG. 71.—Flower of Speedwell, with Fly.

Another common species is figured on Pl. III.

Though our English species are all herbs, we grow in gardens large bushes of species from New Zealand, where Veronicas are of all sizes, small ones high up on the mountains, but woody shrubs at the base.

The Wild Tulip (*Tulipa sylvestris*) occurs in chalk pits in South-West York, Norfolk, Suffolk, and Somerset, but is naturalised elsewhere (Hooker). It has pure yellow flowers, two inches long. Hooker adds, "from Holland southwards." I found it plentiful at one spot in Malta, as well as the Bee Ophrys, growing in *wet* ground close to a little stream, and *not* on the dry limestone of which the whole island is composed! Our garden tulips belong to other species, and are of foreign origin.

The rambler will observe that these "chalk-plants" are mostly to be found just the other side of the North Sea, as in Belgium; so that like the South European types occurring in the south-west, those herein described, as well as the great mass of our common wild flowers, as daisies, buttercups, etc., reached us from the countries on the coast of the continent, when the North Sea, or most of it, was dry ground.

The chalk strata forming the upland "wolds" in the north in Yorkshire extend to Dorset in the south-west, and are called "downs" in the southern parts, as in Kent.

They are grass-covered, with a flora peculiar to them, forming excellent sheep-walks.

The following are some of the herbs found on these downs. The hairy violet (*Viola hirta*) and its specially calcareous chalk-loving variety, *calcarea*. It is a dwarfed starved form with smaller petals.

The Blue Milkwort (*Polygala*) has a chalk species (*P. calcarea*) having a rosette of leaves; it is only a variety of the Common Milkwort (*P. vulgaris*). The structure of the flower is difficult to describe without figures, but it looks somewhat like a small pea-blossom; hence it has been called "falsely papilionaceous." This latter term is applied to the flowers of the Pea family as resembling a butterfly (*Papilio*).

Some members of the Harebell family are found on chalky districts, *Campanula glomerata*, for example; this is so-named because the flowers are clustered together into a sort of head. Another genus of the same family (*Phyteuma*) of which we have two species, one in the chalk downs (*P. orbiculare* (Fig. 72)). It has deep blue flowers, but instead of taking the bell-shaped corolla of the Campanulas, the lower portion only has the five petals *coherent*, the upper parts *stick* together by contact only at the apex, and so form a sort of tube which collects the pollen shed into it by the five free anthers which are included within this corolla-tube. They thus form the "cylinder" for the "piston" action of the style, which as it elongates, sweeps out the pollen beyond the extremity of the tube, just as has been described in composites; only in their case the tube or cylinder is composed of the anthers themselves.

FIG. 72.—*Phyteuma.*

The Gentian has many Alpine species, as all Swiss tourists know, and we shall meet with two on our

Sea Starwort.

Plate xxiii., p. 187. (*Aster Tripolium*).

mountain rambles; but there is another genus of the same family, found in the chalk, called the Yellow-wort or Yellow Centaury (*Chlora perfoliata* (Pl. XX.)). It will be at once recognised by its opposite ovate, smooth leaves united together. Its golden flowers have six to eight coherent petals. Like the Gentians, it has been used in medicine for its bitter qualities.

The Wild Marjoram (*Origanum vulgare*) and the Thyme (*Thymus Serpyllum* (Pl. XX. and Fig. 61)) are common. Both of these belong to the Labiate family.

The Dropwort (*Spiræa Filipendula*) is allied to the Meadow-sweet of moist pastures; but this one affects drought and has tuberous roots, probably for the storage of water, etc., for foods.

A species of Rock-rose (*Helianthemum vulgare* (Fig. 73)), a low plant, is common on chalk. It has yellow petals, and numerous stamens standing erect. If they be grasped gently between the thumb and two fingers and then released, they all spread out horizontally. Like poppies and St. John's-wort, they contain no honey, but offer plenty of pollen to bees, etc., for several different kinds of insects visit the flowers. Fifty-three have been noticed in the Alps of Switzerland visiting this species of Rock-rose.

FIG. 73.—Rock-rose.

Three members of the Leguminous family are not very uncommon—the Kidney-vetch (*Anthyllis vulneraria*), a species of Milk-vetch (*Astragalus hypoglottis*) with blue-purple pea-like flowers, and the Horse-shoe Vetch (*Hippocrepis comosa*). This has yellow flowers and flat curved pods, with a deeply indented margin. It thus breaks up into three to six joints, each containing a seed.

Some members of the Orchis family are more or less frequent on chalk, as the White Helleborine (*Cephalanthera pallens*). This grows to two feet in height, having cream-white flowers. It is, however, a rare plant. Two species of Orchis (*O. purpurea* and *O. militaris*) may be found in the south-east countries. These occur in Denmark and Gothland. The Bee Ophrys (*O. apifera* (Pl. XXII.)), often miscalled Bee Orchis, is common on the chalk downs in the East of England, though the Spider and the Fly Ophrys are rare; both may be found near "Chankberry ring" on the downs beyond Steyning in Sussex, together with the Musk Orchis (*Herminium Monorchis*), with a small green flower. The Bee Ophrys is one of the few of the Orchid family which can fertilise itself. The pollen-masses can fall out of the anthers, but by remaining fixed by their bases, they swing backwards and forwards when the wind blows the stem. The pollen-masses then hit the stigma like the clapper of a bell!

The dark-winged Orchis (*O. ustulata*), sometimes called the Dwarf Orchis, is also found on chalk downs, etc.

Three other species of *Orchis* prevail on the chalk downs as well as those mentioned, *O. pyramidalis*, the flowers being in the form of a cone or pyramid. A peculiarity described by Darwin is that the two pollinia stand on one and the same viscid disk, so that when a moth inserts its proboscis—and the flowers are frequently visited by Lepidoptera—it is guided by lateral ridges of the labellum, a process easily imitated by passing a bristle down the nectary. It thus depresses the pouch or rostellum.

This being effected, the bristle comes into contact with the now exposed and sticky under surface of the suspended saddle-formed disk. When the bristle is removed, the saddle with the two pollinia is removed. Almost instantly, as soon as the saddle is exposed to the air a rapid movement takes place, and the two flaps curl inwards and embrace the bristle.

The pollinia, being attached to the flat top or seat of the saddle, project at first straight up and are nearly parallel to each other; but as this flat top curls round the cylindrical and thin proboscis of a moth, or round a bristle, the pollinia necessarily diverge. As soon as the saddle has clasped the bristle and the pollinia have diverged, a second movement commences, which action, like the last, is exclusively due to the contraction of the saddle-shaped disk or membrane. This second movement is the same as that of *O. mascula* described above, by which the pollinia are depressed through 90°, so as to lie in the same direction as the proboscis or bristle.*

The common Traveller's Joy or Old Man's Beard (*Clematis Vitalba* (Fig. 74)) is a decided lime-plant, being most commonly found on calcareous soils, climbing over hedges by means of the sensitive leaf-stalks. Darwin studied this plant:—" I have seen many proofs that the petioles, in a state of nature, are excited to movement by very slight pressure. For instance, I have found them embracing the withered blades of grass, the soft young leaves of a maple, and the flower-peduncles of the quaking-grass (*Briza media*). The latter are about as thick as the hair of a man's head, but they were completely surrounded and clasped. The petioles of a leaf, so young that none of the leaflets were expanded, had partially seized a twig. Those of almost all the old leaves, even when unattached to any object, are much convoluted; but this is owing to their having come, whilst young, into contact during

* The reader will find the whole process well figured in Darwin's *Fertilisation of Orchids*, p. 22, whence the above is extracted.

several hours with some object subsequently removed. In winter the blades of the leaves of *C. Vitalba* drop off; but the petioles remain attached to the branches, some-

FIG. 74.—Traveller's Joy.

times during two seasons, and being convoluted they curiously resemble true tendrils (Fig. 75), such as those possessed by the allied genus *Naravelia*. The petioles which have clasped some object become much stiffer

and harder than those which have failed in this their proper function." *

This function is of course to hold up the plant. To do this a great strain is necessarily put upon it; the clasped tendril *feels this strain*, and at once sets to work to increase the woody, *i.e.* supportive, tissues.

Darwin mentions *Naravelia*, for this and *Clematis* show how foliar tendrils are made, by dispensing with the blades. It is not a British plant, but we have a herb

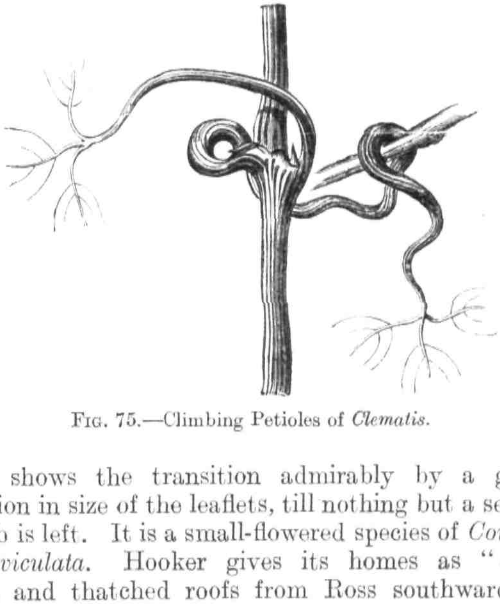


FIG. 75.—Climbing Petioles of *Clematis*.

which shows the transition admirably by a gradual reduction in size of the leaflets, till nothing but a sensitive mid-rib is left. It is a small-flowered species of *Corydalis*, *C. claviculata*. Hooker gives its homes as "copses, banks, and thatched roofs from Ross southward." It grows, *e.g.*, on the Malvern Hills. The leaves are pinnate, the pinnæ three- or five-foliolate. The flowers are straw-coloured, with a very short spur (Fig. 76).

Darwin examined it and records his observations as follows: "A large majority of its tendrils still bear

* *Climbing Plants*, pp. 59, 60.

leaflets, though excessively reduced in size; but others are completely destitute of blades.

"Whilst the plant is quite young, the first-formed leaves are not modified in any way, but those next formed have their terminal leaflets reduced in size, and soon all the leaves assume the form seen in the figure.

"The several terminal branches of the main petiole

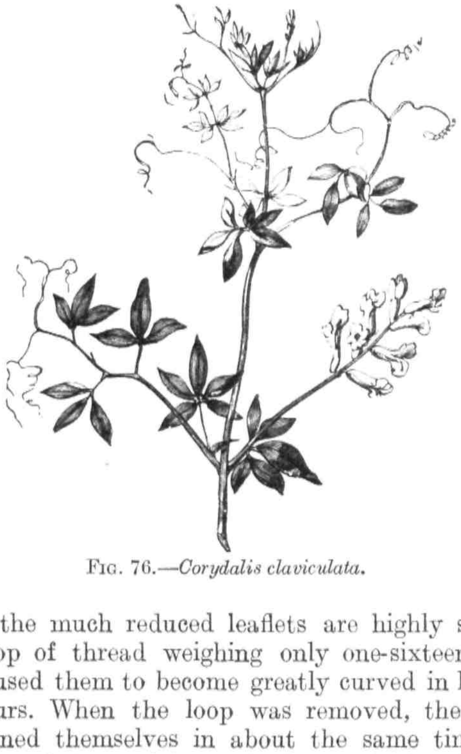


FIG. 76.—*Corydalis claviculata.*

bearing the much reduced leaflets are highly sensitive, for a loop of thread weighing only one-sixteenth of a grain caused them to become greatly curved in less than four hours. When the loop was removed, the petioles straightened themselves in about the same time. The sensibility of the petiole gradually diminishes from the tendril-like extremity to the base.

"The whole leaf, whilst young and sensitive, stands

almost vertically upwards, as we have seen to be the case with many tendrils. It is in continual movement, and one that I observed swept at an average rate of about two hours for each revolution, large, though irregular, ellipses, which were sometimes narrow, sometimes broad, with their longer axes directed to different points of the compass. The young internodes likewise revolved irregularly in ellipses or spires, so that by these combined movements a considerable space was swept for a support. If the terminal and attenuated portion of a petiole fails to seize any object, it ultimately bends downwards and inwards and soon loses all irritability and power of movement."

The Holly (*Ilex*), though to be seen everywhere by cultivation, is locally abundant as a wild plant on chalk. It has been gravely asserted that holly leaves are only prickly on trees as high as a beast can reach, but at the top it has no spines; that spiny processes of all sorts are a provision of nature against browsing animals. The truth is that they are the result of drought as explained in the case of the Rest-harrow. A vigorous shoot of holly may have small leaves without spines at the base, when vigour was beginning; normal, large spiny leaves in the middle, when growth was most active; and later on small spineless leaves again appear as the annual energy is declining. Moreover, hollies often grow to twenty feet in height, with spiny leaves throughout, and if spineless ones *do* occur at the top, it is only the result of lessened energy. A cow has been known to be partial to some holly bushes within reach, which had to be protected, just as another would eat stinging nettles; and the camel lives upon the "Camel's-thorn." This animal has a hardened pad to the roof of the mouth, so feels no inconvenience in eating it.

The Holly is mostly cultivated as an ornamental tree or for hedgerows when it is kept clipped. Several varieties of form of leaf have arisen as well as differences in colour, white and yellow being common.

The holly berries and leaves have been used in medicine; but the wood, which is very white, is valuable, for it is hard and of a fine grain. It takes a good polish, and is readily stained, so that when black it is a fair imitation of ebony. Consequently, it has been much used in inlaying and cabinet work; and is one of the ingredients in Tunbridge-ware. It has also been used for wood-engraving.

FIG. 77.—Spindle-tree in Flower.

One species of holly is the Peruvian or Paraguay Tea (*Ilex Paraguayensis*). The Tea is an infusion of the crushed shoots, having apparently the same chemical principle as tea and coffee. It is interesting to find the peasants of the Black Forest using the ordinary holly for the same purpose. Probably it contains a principle analogous or identical with that of Paraguay tea. Another species is used in Carolina also for making tea. The Indians use the leaves for smoking.

In Paraguay it is called *Matte*, and the tea is drunk with a pipe, through a hole in the gourd in which the tea is made, called a *bombilla*.

Strawberry.

The Spindle-tree (*Euonymus Europæus* (Figs. 77 and 78)) is a characteristic calcicole, as botanists call all plants which "dwell" on "calcareous" soils. It is remarkable for its four green-petalled flowers and pink points with orange-

FIG. 78.—Spindle-tree in Fruit.

coloured seeds, which are poisonous, but very attractive to children. The bark, leaves, and fruit are all injurious.

It is not at all uncommon in hedges. The wood is hard, and therefore used for butchers' skewers, hence its other name of prick-wood. The wood is also used for charcoal. The seeds boiled yield a good yellow dye.

The Buckthorn (*Rhamnus catharticus* (Fig. 79)) is another calcicole, as well as the Common Sloe; but the Bullace and Cherry only occasionally occur. The latter (*Prunus Cerasus*) is the origin of the Morello, Duke and Kentish Cherries. The structure of the flower of the Sloe (*P. communis*) has been described elsewhere (Fig. 3).

FIG. 79.—Buckthorn.

The Dewberry (*Rubus cæsius*) is locally abundant. It is regarded as a sub-species of the Blackberry by Hooker. It is usually prostrate; the leaves have only three leaflets, green on both surfaces. The berries have only a few large drupels. The origin of the pinnate compound leaves of the genus *Rubus* may be here described. A leaf under the flowering shoots is simple, being a single blade, lower down a leaf may be found with two basal lobes, then in others the two lobes are represented by separate leaflets, and the ternate leaf is formed.

Again, these two latter may also become lobed, and finally a leaf with five leaflets will be met with.

In the Raspberry (*Rubus Idæus*) the compound leaf begins as above, but the second pair arises, a *second* time from the terminal one.

This process can be easily seen in the potentilla, the leaflets ranging from one to seven.

Of species of Roses, the Burnet rose (*R. spinosissima*) is very characteristic. The leaves have from seven to nine leaflets; the flowers may be white or pink. It has very numerous prickles, as the name implies. A sub-species of the sweetbriar is also a calcicole (*Rosa rubiginosa*, sub-sp. *agrestis*). Another calcicole is the White Beam (*Pyrus Aria*), allied to the apple and pear, which

are also species of *Pyrus ;* but the White Beam has pinnate leaves, woolly below, with red berries.

The Deadly Nightshade (*Atropa Belladonna* (Fig. 37)) is included as a calcicole, but as it occurs elsewhere it is described with its allies under " Waste Places." Similarly the Spurge Laurel affects chalk, but as it is found in woods, it and its ally, the Mezereon, will be dealt with later on, as well as the Butcher's Broom.

The Box-tree is well known at Box Hill. It is a calcicole, and is regarded as indigenous in Kent, Surrey, Bucks, and Glo'ster ; but it is cultivated everywhere. It grows to about twelve feet in height. The sexes are distinct on the same plant. The male has four sepals and stamens ; the female four to twelve sepals and a three-celled pistil. As it grows from Belgium southward, that country was probably the source of our supply.

Box-wood was well known to the ancients. Ezekiel says : " They have made thy benches of ivory inlaid in box-wood."* The Septuagint has the Greek word *puxos*, corresponding to the Latin *Buxus*, and hence the English " box." The word *puxion* meant a writing-tablet made of box-wood, and probably came to mean a tablet in general ; because the ten commandments were said to be written upon *puxion lithinon*, *i.e.* " stone tablet."

The Box was a favourite bush with the wealthy Romans, who used it freely for what was called " topiary " work ; that is, training the bushes into fanciful shapes of animals, etc. Box edging was largely used in the eighteenth century for geometrically shaped flower-borders. The origin of the term is from the Greek word *topion*, meaning a " small place," probably such was devoted to this quaint style of ornamentation.

Box-leaves have been used in medicine, but apparently discontinued at the present day. The wood was most valuable for wood-engraving, as it is solid, very close grained, and takes a fine polish, and all the illustrated

* Ezek. xxvii. 6.

books and journals were indebted to this tree before photography was invented. The wood is employed for mathematical scales, turning, etc. The supply came from Spain and other places on the Mediterranean. It is recorded that extensive plantations were made of it by the Earl of Arundel on Box Hill, near Dorking, in Surrey, and that the clearings of these plantations in 1815 yielded £10,000.

A curious feature about the leaves is that the skin on the underside is not adherent to the tissue below it; except along the margin, so it can be easily raised with the tip of a pen-knife.

The Yew, like the Juniper, is another of the three members of the class Gymnosperms; these two being naturally calcicole, while the Scots Pine (*Pinus sylvestris* (Pl. XXXII.)) is only native on the Scotch mountains.

The stamens of the Yew (Fig. 80) occur in little clusters, with only a few very small scales below them. They are never borne on the same tree as the female flowers.

Each stamen of the cluster looks like a miniature yellow mushroom, having several anther cells suspended round one central stem, all bursting downwards. The female flower consists of a solitary ovule surrounded by very small bracts. This enlarges and becomes the naked seed at the bottom of a scarlet, fleshy cup, which is an extra growth developed as the seed ripens. The Yew leaves and seed are *very* poisonous, and many cattle have died from eating the foliage. Children often eat the scarlet cup, which is harmless and sweet, but the *green seed within it* is liable to produce fatal results.

The last to be mentioned is the Juniper (*Juniperus communis*). This grows from one to five feet high. The leaves are awl-like, whorled in threes; and sharp pointed, being about one inch long. The male and female flowers are distinct. The male catkins consist of roundish scales bearing two-celled anthers. The female consist of a scale with an ovule at the base, three being clustered together. The scales ultimately cohere and make a covering to the

three seeds, forming the Juniper berry; but it must be understood that there are *no carpels*, each ovule is open to the air at first and receives the pollen grain *direct*; hence the Juniper belongs to the class Gymnosperms, or "naked-seeded" plants. It was this class which formed the original link or stepping-stone between the

FIG. 80.—Yew Tree.

higher flowerless plants, the Ferns and Fern-allies, and Dicotyledons with true carpels and pistils.

Between the rolling downs and the beech or other woods on the lower slopes, is what is called "scrub," consisting of shrubs, etc., more or less of a calcicole character. Old chalk-pits, sides of cart-roads, etc., mark the localities.

Mr. A. G. Tansley and Mr. W. M. Rankin have made this chalk area a special object of study, and I am indebted to those observers for enumerating such plants as they discovered to be especially characteristic or are "calcicole." They observe that "the chalk scrub" often grows exceedingly thick, and then excludes almost all ground species. Then the Dog's Mercury (*Mercurialis perennis* (Fig. 81)) often occurs in sheets under its shade (though this plant is pretty well ubiquitous elsewhere than in chalk districts). Among these woodland species are several of the characteristic chalk orchids, such as *Cephalanthera longifolia*, *C. grandiflora*, *Helleborine* [*Epipactis*] *atrorubens*.

FIG. 81.—Dog's Mercury.

These authors specially call attention to the following as being markedly calcicole in the chalk scrub: Traveller's Joy, Spindle-tree, Buckthorn, Burnet Rose, White Beam, Guelder Rose, Deadly Nightshade, Spurge Laurel, and Box. They are associated with others especially abundant, as Maples, Sweetbriar, the Dog and Field Roses, a variety of the Hawthorn, Bryony, Privet, Hazel and Juniper.

We now reach the trees on the chalk slopes, as we have rambled over the turfy summits. These are mainly Beeches, Yews, Ashes, and occasionally Oaks. The soil is too shallow on the downs, but where it has accumulated in the slopes and valleys, woods are met with.

Though the Beech may form the bulk of the wood, some other trees occur, as the Gean (*Prunus Avium*). This is the wild source of our cultivated cherries called Geans, Hearts, and Bigaroons.

The Yew tree is also a frequent inhabitant of beech woods underneath the "canopy" of the beeches. Small shrubs and herbs are not abundant, as the leaves of the beech obscure both light and heat fom the ground. Perhaps this is why certain "saprophytic" orchids and the so-called yellow Bird's-nest or Pine-sap (*Hypopitys multiflora*), apparently a degraded form of a member of the Heath family, is abundant. It is a curious plant, having no green leaves, but it has an erect cream-white stem, from six to twelve inches high, bearing many drooping flowers, with yellowish scales instead of leaves. The cause of this degeneracy is the habit of living on decayed vegetable matters. It therefore requires no "chlorophyll," the green-coloured substances of ordinary leaves, by which such plants can, and usually only, live on inorganic mineral food and the carbonic acid gas of the air. The Bird's-nest Orchis (*Neottia Nidus-avis*) is a similar saprophyte; so called because it produces clusters of roots, each of which can have a bud at the tip by means of which the plant can be propagated.

Beechwoods mostly occur on the lower slopes of the chalk downs, and Hooker mentions one at Ashridge 118 feet; another with a girth of 29 feet (Bicton, Devon); and one with a head 352 feet diameter (Knowle beech). The tree is not rugged like the Oak and Elm, but with a smooth bark. It often bears nodules on the surface. These are called "embryo buds"; for they are never elongated, but increased in diameter; and as the original point of attachment was very small, they can often be extracted by a push with the thumb.

As a rule few or no herbaceous plants grow under beeches in consequence of its deep shade.

Like those of the Oak, the male flowers of the Beech are in catkins, and consist of a calyx with many stamens. The female has a four-lobed cup, made of coherent, woody bracts with two to four pistils. These form the "masts" with edible cotyledons within them.

RAMBLE XII

By the Sea and Salt-marshes

A considerable number of inland plants have varieties or species, according to the views of different botanists, by

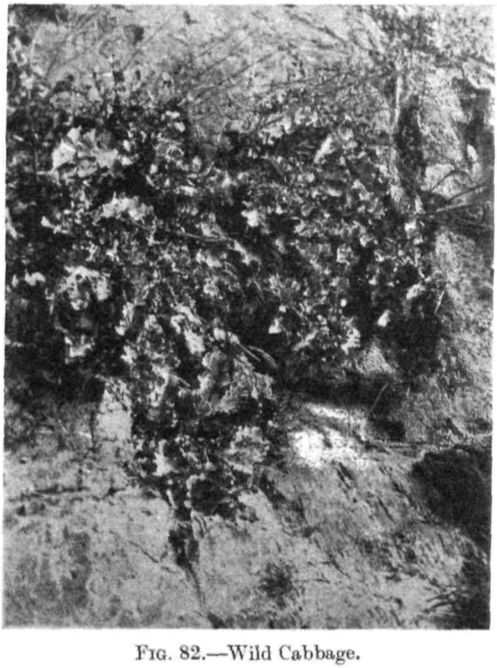


Fig. 82.—Wild Cabbage.

the seaside. The prevailing characteristic is a greater thickness or fleshiness in the leaves. It has been proved experimentally that this is due to the presence of salt absorbed by the plant; for several, such as the Garden Cress, have been induced to make similarly thick leaves by being watered with salt and water. This is why we sprinkle our Asparagus beds with salt, to make the stems more succulent.

A few examples will illustrate this common feature. The scentless Chamomile (*Matricaria inodora*) has a "maritime" variety with fleshy leaves. The Common Mugwort (*Artemisia vulgaris*) has an ally called Worm-seed (a medicinal plant). The Bladder Campion is another, and many more might be mentioned.

FIG. 83.—Many-headed Cabbage.

In any kitchen gardens we may see rows of cabbages, kales, brocoli, and cauliflowers. Whence came they? These and many varieties of them are all members of the cabbage species (*Brassica oleracea*) of our coasts, growing plentifully on the chalk cliffs of the South-East of England (Fig. 82).

The kale was much the same as the wild plant, as figured by Gerard in 1597; now there are numerous, vastly improved sorts. But the "crisped" was known in the sixteenth century. In this the leaf bulges between the "veins," in consequence of an excess of growth. A

FIG. 84.—Origin of Kohl-rabi.

curious, many-headed sort is seen in Fig. 83, the forerunner of the Brussels sprouts. In this last the terminal head (as of a cabbage) is arrested, so that the energy of growth is divested into the lateral buds, which form miniature heads instead. It has now become normal, and a fixed character in the present form.

It is, however, sometimes induced by an accidental injury by the hoe in weeding when the terminal bud is cut off. The Kohl-rabi had begun its career, as we may see in Fig. 84, with the swollen stem. The Cauliflower was a very poor thing in those days. In Fig. 85 it is almost invisible among the mass of foliage. The present Jersey kale with stems six feet high was unknown. Sowing the seed of this variety in the peaty soil of Bournemouth, it refused to grow more than eighteen inches in height!

FIG. 85.—Cauliflower of 16th Century.

Cabbages were one of the favourite foods of the ancient Romans; but Cato only knew of six sorts; they would be more like sixty at the present day. One variety which Pliny describes as "shoots," which appear to have been the flowering shoots, but not round and compact, as in our cauliflower. At all events, the form still grown in Malta is a diminutive type, consisting of a cluster of separate, rather long, flowering shoots.

The Tamarisk (*Tamarix gallica* (Fig. 86)) has been planted by the seaside in the South and East of England, and may elsewhere have escaped. It is a small shrub a few feet in height, the branches being very slender with minute leaves. It bears small pink flowers on spikes one inch long. It is a native of south coasts of Europe. The

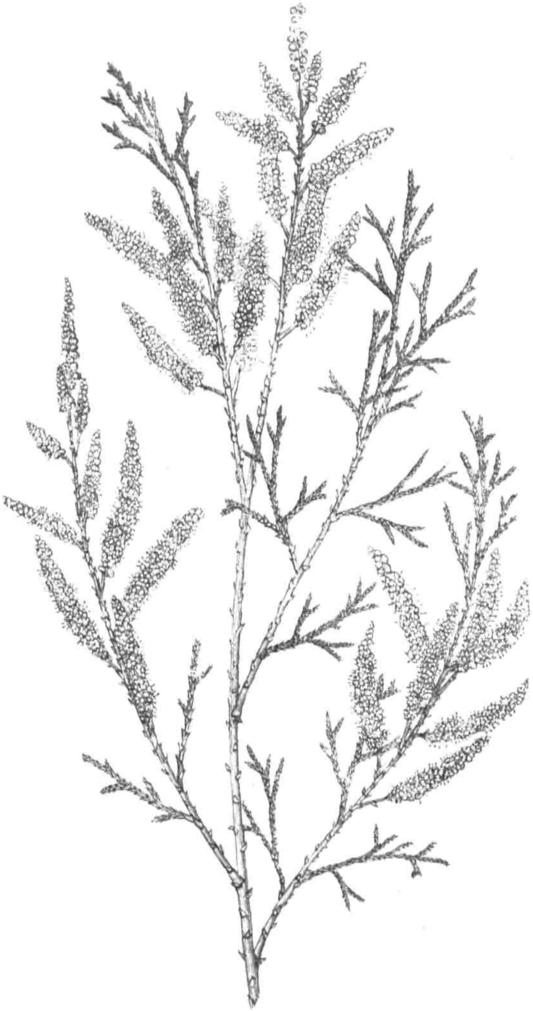


FIG. 86.—*Tamarix.*

name is derived from the river Tamaris of Spain. Certain species of Tamarisk are desert trees, and are alluded to in Scripture. Thus Jeremiah, prophesying judgments upon Judah, says: "Cursed is the man that trusteth in man, and maketh flesh his arm, and whose heart departeth from the Lord. For he shall be like the Tamarisk tree in the desert, and shall not see when good cometh; but shall inhabit the parched places in the wilderness, a *salt* land, and not inhabited."

The mention of salt has a peculiar significance in the case of the Tamarisk; for it imbibes the salts dissolved in water by the roots, and as the latter escapes from the foliage, the salts are left on the surface. These subsequently absorb the heavy dews which occur in the hot months when no rain falls, and are thus enabled to supply the tree with water; according to the observations of the late Dr. Sickenberger of Cairo.*

The Tamarisk was known to the Greeks under the name *muriké*, the word used by Jeremiah, as translated in the Septuagint. It is perhaps recognisable in the consonants of the last two syllables of ta-*mar*-*isk*.

The reader will see from the illustration how barren of leaves the Tamarisk *appears* to be; but in reality the shoots are thickly covered with minute leaves, shown by the pointed, overlapping scale-like appearance. The spray will be seen to have dense masses of very small flowers.

The Bladder Campion or White Bottle, so called from the corolla and inflated calyx (*Silene Cucubalus* (Pl. XIII.)), is a common plant by roadsides and waste places. It will be seen to have opposite leaves with smooth margin and white flowers, the petals being deeply cloven. The variety, or as some call it, the species, *S. maritima*, only differs in having fewer flowers (one to four instead of many), and in being generally a compact plant on the ground instead of erect; the petals, too, are not quite so deeply

* *Plants of the Bible* (G. Henslow), pp. 209, 270 (Bagster).

cleft, as Hooker says: "It is very nearly allied to the above." In fact, it is simply the maritime form due to the local conditions, the extra fleshiness of the foliage being the result of salt.

The young shoots have been boiled and eaten, being quite wholesome, if not to the taste of all.

There are two genera of the same family as the last (to which pinks and carnations belong); they consist of several species of small plants growing in sandy or rocky places, and therefore have become more or less impoverished. They are the Sandworts (*Arenaria*), the Pearl-worts (*Sagina*). To these might be added the Sandwort Spurrey (*Spergularia*). Each is represented at the seaside by a maritime species, *Arenaria peploides*, *Sagina maritima*, and *Spergularia salina* and *Sp. media*. The first is recognisable by its creeping habit, so common on sandy shores, and its fleshy leaves. The flowers are only a quarter of an inch across; the leaves are from a quarter to half an inch long. It is known as the Sea Purslane, and used for pickling in the north.

Sagina maritima is regarded as a "form" of *S. apetala* by Hooker. It is a small annual with minute or no petals. It occurs like the Sea Purslane on sandy sea-shores.

The Sandwort Spurrey somewhat resembles the Common Spurrey, as it has a similar foliage of slender leaves; the corolla is white or red. We have four species of which Hooker remarks: "The species are very variable, and may be regarded as sub-species of one. The first occurs on sandy soils; the second, *S. salina*, and the third, *S. media*, live in muddy places near the sea; while the fourth, *S. rupestris*, prefers rocky places near the sea according to Hooker, so the rambler will probably find one or other of them. Of course by the sea they may be all expected to be more or less fleshy.

The Sea-rocket (*Cakile maritima*) is a common cruciferous plant, having branches one to two feet long, bearing fleshy leaves and four-petalled white or purplish flowers.

The Tree-mallow (*Lavatera arborea*) is a native of maritime rocks. It grows from three to six feet high, and is occasionally cultivated in gardens by the sea. It has large purple flowers.

The Sea Buckthorn (*Hippophae rhamnoides*) is another shrub, from one to eight feet high. It has silvery-like leaves. The staminate and pistillate flowers are separate, and it bears orange-yellow fruit.

With regard to the uses of this plant, the fruit is acid, and though not very agreeable in flavour, is eaten by children. The Siberians and Tartars make a jelly from the berries and eat them with milk and cheese; while the inhabitants of the shores of the Gulf of Bothnia prepare from them an agreeable "rob" which they use as a condiment to their fish. Yet in some parts of Europe they are considered poisonous, and a story is told by Rousseau of a person who saw him eating them, and, though believing them to be poisonous, had too much respect for the great man to caution him against the supposed danger! In some districts of France a sauce is made from these berries and eaten with fish and meat. A decoction of them is said to be useful in cutaneous eruptions. The colour may be extracted by hot water and used as a dye for woollen stuffs, but it is not very brilliant when so obtained. This plant runs very much at the root, and by its long suckers often assists in binding loose sandy dunes on which it grows.

The Fennel (*Fœniculum officinale*) is a maritime plant. It occurs, for example, at Barmouth, and abundantly on the slopes above the beach at Bournemouth. It has yellow flowers with finely divided leaves, suggesting the possibility of its having been ancestrally an aquatic plant. It belongs to the Umbellifers.

The origin of our common Garden Radish (*Raphanus maritimus*), occurring on sands and rocky shores and maritime fields, is probably a maritime form of the Wild Radish (*R. Raphanistrum* (Fig. 87)) of cornfields. The

pods are peculiar in not splitting open as in the Wallflower, but each seed is closely inserted by a portion of the carpel, so that it looks like a string of beads which become separate. The seaside radish has much fewer than the cornfield

FIG. 87.—Wild Radish.

species. The origin of the "turnip" radish was by sowing the seed in a stiff soil, which naturally prevented the downward growth. It became hereditary in most garden soils, but if the seed of the turnip-radish be sown in a very light sandy soil, a large proportion will "revert" to the wild form.

M. Carrière collected seed from the Wild Radish and sowed some in the light, alluvial soil near Paris, and other seed in a very stiff clay soil in the South of France. He obtained a greater percentage of long roots in the former

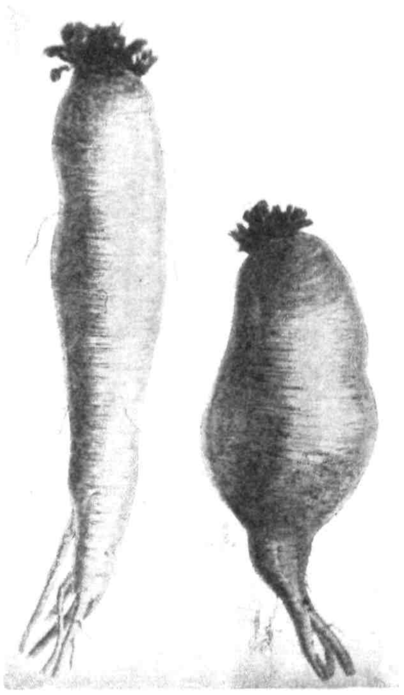


Fig. 88.—Radishes raised from a Wild Plant. (After Carrière.)

and turnip forms in the latter. Two of the former are here given (Figs. 88, 89).

We have two maritime ferns, a Spleenwort and the Maidenhair found in seaside caves and damp rocks. The former (*Asplenium marinum*) has fronds from three to ten

inches long, with pinnules. The Maidenhair, of which genus (*Adiantum*) several foreign species are grown in glass houses, is *A. Capillus-Veneris*, with delicate stems black and polished. The frond grows from four to twelve inches, bearing numerous membranous pinnules. It is found from Dorset to Cornwall, Wales and the Isle of Man.

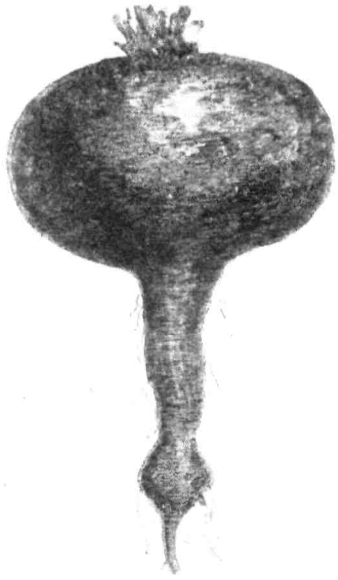


FIG. 89.—Radish raised from a Wild Plant. (After Carrière.)

It is one of the South European group of plants located on our western side.

A very variable little plant with rose-coloured blossoms is common on sandy coasts and dry pastures. It is called Centaury (*Erythræa Centaurium*). This plaut belongs to the Gentian family; the opposite leaves are more or less connate; the maritime form is called *E. littoralis*. It has

the same bitterness as the Gentians, and has long been used as a tonic and febrifuge (Pl. XXV.).

We supposed our pasture-land in our second ramble to slope down to a river and the river runs to the sea. As it approaches the ocean, it of course has become a wide river flowing through an alluvial plain. It remains fresh down to a variable distance from the seaside; we then approach sea-marshes flooded by salt water. Many of these salt-marshes have been protected from the sea and recovered as cultivated land. The "Marshland," as it is called in the East of England, is now very extensively cultivated, having been rescued along the rivers running into the Wash.

There are various kinds of land which may be all called maritime, such as dunes of blown sand, sand and shingle beaches, besides the mud flats. Each has its special kinds of plants.

The following are the principal plants of sandy or shingly sea-shores and sand-dunes.

The Horned Poppy (*Glaucium luteum*) is a handsome plant some two feet in height with leaves some inches across, of a bluish-green colour, as in many maritime plants. This is due to the presence of a thin coating of wax. It bears golden yellow flowers two to four inches across. It has four petals as in poppies, being of the same family. The pod grows to a foot in length, which suggests the name.

The Sea-kale (*Crambe maritima*) is not common, but is found locally in sandy and shingly sea-coasts. It has similar bluish-green leaves about a foot in length, broadly ovate in form. The flowers have four white petals, being a crucifer. It has been cultivated in England for some few centuries.

The Wild Sea-kale is the source of our cultivated plant. It has a thick rootstock or underground stem. The inhabitants of the West of England have for a long time been accustomed to cut the soft shoots out of the sand in the early spring and eat them boiled, like asparagus. Its use as

a culinary vegetable is recorded by Parkinson (seventeenth century) that it was cooked as cabbage is in his day. Our seaside peasantry sometimes strip the peel from the stalks and thick midribs of the leaves, and use the remaining tender portion in soups or simply boiled.

The Sea-holly (*Eryngium maritimum*) is a conspicuous plant on sandy shores, growing to two or more feet in height, with glaucous, *i.e.* bluish, leaves and dense heads of flowers of a bluish-white colour. Though suggesting a composite, the flowers and fruits reveal its umbelliferous character, though the umbels are replaced by heads. Bees are so busy with the flowers that the people call it the "Bee-flower" on the East Coast.

With regard to grasses, the most conspicuous is the Marram-grass (*Ammophila arundinacea*), covering the sand-hills by the sea. Like so many other sand plants it has extensively creeping underground stems, which are invaluable for binding the sand-dunes. The leaves are long and stiff. It bears a panicle of florets to some six inches in length.

Another creeping grass is allied to Wheat (*Triticum junceum*), often replaced as a sand-binder in other places by a Sedge (*Carex arenaria*). The creeping stem will run for several feet under the surface, sending down roots and upward tufts of leaves at the successive joints. It would seem that the incoherent sand, and in the increased heat which it acquires, stimulates the subterranean creeping stems; for other plants, as wild mint, etc., form extensive creeping stems which they do not make in terrestrial soils, if stiff. The Barley-grass (*Hordeum murinum*), referred to as a frequenter of waste ground, produces a form in sandy places with "the stem below branching and rooting" (Babington). As another instance, the common Fescue-grass (*Festuca ovina*) has a sub-species, *rubra,* with a sand-form (*arenaria*); the characteristic feature is that it produces subterranean creeping stems, like the first mentioned, and normally maritime.

There are three rare grasses; one of which is to be found by those who go to Saffron Walden, in Essex, where the Hare's-tail grass (*Lagurus ovatus*) has naturalised itself; but it is common in Guernsey and the South of Europe. It derives its name from the soft, oval or globular tuft of flowers with long feathery awns. It grows from six to ten inches in height.

The second is the Dog's-tooth grass (*Cynodon Dactylon*), only occurring wild on the sandy shores of Dorset to Cornwall. The stems are from four to ten inches in height. It creeps extensively like so many plants at the shore, being encouraged, as stated, to do so by the hot and moist sand. It bears purplish spikes. It is the chief pasture (*Doab* and *Bermuda grass*) of many dry climates (Hooker).

The third is found in wet sand near the sea in Anglesea. It is one of the South European group, as it occurs in Italy, Spain, and the Channel Islands.

It is only from one to three inches in height and tufted, with tiny leaves. Botanists have given it four different names as genera; of which Hooker selects *Mibora verna*.

The genus *Convolvulus* is usually associated in one's mind with the power of climbing, as of the little and common Bindweed of our cornfields and roadsides, etc. This habit, however, remains in abeyance when the plant has nothing wherewith to climb up. Thus a warm, sunny bank may be covered with the Bindweed (*C. arvensis*), which then spreads horizontally. Similarly the large-flowered *C. Soldanella* of our sandy sea-shores is rarely found climbing, because it has quite changed its habit in adaptation to an open sandy soil. This condition favours the production of underground creeping stems, as seen in the grasses and sedges which find the sand-dunes. This species of Convolvulus also has extensively creeping stems. The leaves are fleshy, round, or kidney-shaped, while the flowers are an inch and a half across of a pale purple or pink colour, but of the usual trumpet shape.

A herb belonging to the Primrose family called Brook-

weed (*Samolus Valerandi*) occurs in wet ground and ditches, especially near the sea. It grows from one to two feet in height, with shining green leaves, one to four inches long. It bears racemes with very small white flowers. The little tubular corolla is interesting because it reveals the anomaly in primroses in having the five stamens *not* alternating in position with the sepals, as is the rule, but *in front* of the petal-lobes, which is abnormal; but in the Brook-weed five little stumps are left, all that remains of the five stamens in front of the five sepals. Hence it is inferred that the Primrose family had originally *ten* stamens, but the five outermost of them are now suppressed.

The Sea Milkwort (*Glaux maritima*) is another maritime plant of the Primrose family, found on sea-shores and estuaries.

It is a small succulent plant with a creeping stem, being not more than from six to ten inches in height. The calyx is cleft into five lobes and coloured; there is no corolla. There are five stamens *alternate* with the calyx lobes. The usual five, *opposite* the petals in a primrose, are suppressed in the Brook-weed.

Though the members of the Borage family are characterised by a very rough foliage, yet one seaside plant, *Mertensia maritima*, occurring on sea-shores from Wales and Berwick to Shetland, is a succulent plant, showing the influence of the salt. It grows to two feet in height, with blue-purple flowers, with a campanulate corolla. It was named after Professor F. C. Mertens, a German botanist.

The Cotton-weed (*Diotis maritima*), a composite, contrary to the usual condition of seaside plants, being smooth and fleshy, is an "erect perennial herb, densely clothed with felted, white grey or buff wool," as Hooker describes it. It has flower heads, growing on the sea-shores along the South and East coasts. It is about ten inches high; the heads are small, in dense clusters. It is a South European plant found along the Mediterranean shores.

There is a species of Pea (*Lathyrus maritimus*), only found on the shores of the East coast, as in Kent. It has three to five pairs of leaflets, the flower-stalks having from five to ten blossoms nearly one inch across, and purple in colour.

It is a local plant from "Shetland to Kent and Dorset" (Hooker). It occurs, for example, on the beach at Walmer.

We have only one genus which lives and blossoms and fruits in the sea. It is called the Grasswrack (*Zostera marina*). The rambler may have seen the long, narrow leaves thrown up upon the shore, as it is common in estuaries between high and low water. Its leaves are about three feet long, and one-eighth of an inch broad. It has a spathe about ten inches long with green flowers, the male and female being arranged in two series of one or two anthers, and a pistil of two carpels. This shows the extreme degradation to which submerged flowers can reach. Moreover, the pollen is not globular, but consists of slender tubes.

The leaves are collected for stuffing cushions or mattresses, etc. Also for packing fragile articles, as glass and earthenware. They are also collected like the seaweed for manuring purposes.

We have two species of Scurvy-grass (*Cochlearia officinalis* and *C. anglica*) on sea-shores, etc. They are perennial herbs with fleshy leaves, and small white, cruciferous flowers, as they belong to the Crucifer family. They grow to ten inches in height. They bear nearly globular seed-vessels unlike the usually long pods of crucifers.

"The whole plant abounds in a pungent oil. It is to the presence of this oil that the well-known antiscorbutic properties of the herb are due; its virtues, however, may have been exaggerated, but there can be no doubt that the leaves form a very wholesome salad in the spring, though scarcely superior to water-cress. On the continent the essential oil has been applied in paralytic cases and for rheumatism in England.

"The Scurvy-grass was well known to early navigators

as a remedy for the scurvy, which formerly proved so disastrous on long voyages. It was brought to notice by

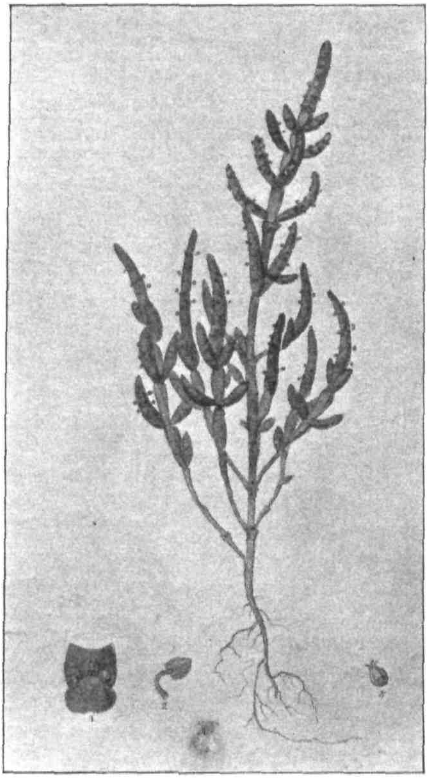


FIG. 90.—Marsh Samphire.

Captain Cook, who used it when in the Southern Seas" (C. Pierpoint Johnson).

Salt marshes have their own special group of plants which have thoroughly adapted themselves to salt. They are the Marsh Samphire (*Salicornia herbacea* (Fig. 90)),

Wood Sorrel.

the Seablites (*Sucæda*, sp.). The former looks as if it had no leaves, only fleshy swollen internodes; but these have the leaves *adherent* to the internodes, the tiny point being the true apex of the leaf. As the roots require more air than the salt mud can supply, the top of the root or base of the stem has a loose covering of cells, allowing for the air to penetrate within them.

Of large plants, there are the Sea Starwort (*Aster Tripolium* (Pl. XXIII.)), a composite three feet high with fleshy leaves of a lanceolate shape, and heads nearly an inch across with purple ray and yellow disk florets.

The Garden Thrift (*Armeria vulgaris*) occurs rather on the rocky sea-shores than in the mud. It illustrates a curious fact occurring with some other plants, that seaside plants may often be found on high mountains. Thus the Thrift occurs by the seaside in lowland situations, but reappears at a height of 400 feet in the Highlands. The maritime plantain (*Plantago maritima*) is another which at a height of 1800 feet in Scotland becomes a variety of the (foreign) *Plantago alpina*.

The wild form of the Beetroot (*Beta maritima* (Fig. 32)) is frequent round our coasts. It may be found both in a muddy sea-shore or on the cliffs among the grass. It is a perennial herb, with a branching root-stock tapering to a somewhat fleshy root. It has spikes of small green flowers, which *cohere in fruit* by their bases, which become hardened. Under cultivation it has become a biennial with a vastly increased root which abounds in sugar. Mangold Wurzel is another form of root of the beet cultivated for cattle. Chard (Fig. 91) is the name given to the leaves when eaten.

Four species of Orache (*Atriplex littoralis*, *A. laciniata*, *A. portulacoides*, and *A. pedunculata*) frequent the sea marshes. The species the rambler will be generally familiar with is *A. patula*, common in all waste places, manure heaps, etc. The leaves are often hastate, like

a spear's head, and "mealy" or "scaly" in appearance. The flowers are one-sexual; the male has a calyx of usually five sepals with five stamens, sometimes only three of each. The female has only two sepals sometimes coherent.

The separate sexes and two sepals to the female flower

FIG. 91.—Chard. (After Burpee.)

distinguish this genus from the Goosefoots (*Chenopodium*), to which they are closely allied.

A. littoralis has narrower and never hastate leaves like *A. patula*.

A. laciniata is silvery-white all over, being clothed with silvery scales, which are greyish-white in *A. portulacoides*, the leaves being obovate, *i.e.* broadest at the end. The last is rare, and only found on the East Coast.

The plants of salt-marshes and sea-coasts naturally imbibe a quantity of salt. There is the Glass-wort (*Salicornia* (Fig. 90)), the Salt-wort or Prickly Glass-wort

(*Salsola*), of which *S. Kali*, common on our shores, was used, being burnt to recover the crude carbonate of soda, known as "barilla"; and Sea-blite or White Glass-wort (*Suæda*).

Two uses of these are mentioned in the Bible, for soap and for glass. Thus Jeremiah says to Judah: "Though thou wash thee with nitre (*nether*, Heb.), and take thee much sope (*borith*), yet thine iniquity is marked before me."

With regard to the manufacture of glass, Pliny writes as follows: "In Syria . . . there is a marshy district known by the name of Cendetia. In this district, it is supposed, near the river Belus . . . at the reflux of the tide, the river discloses its sands. The shore upon which the sand is collected is not more than half a mile in extent; and yet for many ages this was the only spot that afforded the material for making glass."

"The story is, that a ship laden with nitre [probably *natron*, the carbonate of soda], being moored upon the spot, the merchants, while preparing their repast upon the sea-shore, finding no stones at hand for supporting their cauldrons, employed for the purpose some lumps of nitre, which they had taken from the vessel. Upon its being subjected to the action of the fire, in combination with the sand of the sea-shore, they beheld transparent streams flowing forth of a liquid hitherto unknown to them. This, it is said, was the origin of glass."

Both Strabo and Josephus maintained that the sand of this district was esteemed peculiarly suitable for glass-making, and exported in great quantities to the workshops of Sidon and Alexandria, long the most famous in the ancient world. Pliny corroborated this, saying, "Sidon was formerly famous for its glass-houses, for it was this place that first invented mirrors." But it does not appear to have been a successful innovation, as no further mention is made of them, nor as to how they were constructed; no such mirrors have been found as far as

the writer knows. The mirrors of the ancients were of polished metal.*

A rather rare grass (*Spartina stricta*) occurs in muddy, salt creeks, etc., from Lincoln to Devon and Kent. It grows to a foot and a half in height, with slender, rigid leaves. It bears long spikes which are only one-flowered. The Rootstock creeps underground extensively. A variety is at Southampton and Poole, where it is gradually reclaiming the border of Poole Harbour in certain parts.

Another grass of maritime marshes is *Gastridium lendigerum*. It grows to ten inches in height, is an annual, and bears small panicles, somewhat contracted, with one-flowered spikelets, having slender awns. It occurs from South Wales, Warwick, and from Norfolk southwards. This is one of the South European and Channel Island group ; and some botanists are hardly inclined to regard it as a true native. It is known as the Nit-grass. It seem to have won its way from the South of England to the middle portion.

The late Mr. Robert Smith has explained how the barren sand of the sea-shore first becomes a sand-dune or undulating elevated district, and how it gradually gets peopled with vegetation. The following is taken from the report already referred to and abridged : " *Vegetation of Sandy Shores and Sand-dunes.*†—Excellent examples of this vegetation are found in Forfar and Fife. . . . The chief orographical feature of a sand-dune is an alternation of ridge and hollow. Winds and sea-currents are the most important factors in the formation of the ridges, for one can trace their commencement in those low spits or ridges of sand running obliquely into the sea below high-water mark, and on which one may walk dry-shod after the rising tide has flowed into the hollow between the spit and the shore.

" Vegetation soon begins to play a part in the building

* The above is quoted from my book, *The Plants of the Bible* (Bagster).
† *Botanical Survey of Scotland*, III. and IV., Forfar and Fife, p. 67.

up of the ridge, and the first plants may be found on ridges which are still liable to inundation in the highest or spring tides. The Sea-couch grass (*Agropyrum* [*Triticum*] *junceum*) and the Sand Sedge (*Carex arenaria*) are generally the first colonists; both are adapted by their long, creeping, underground stems and by their tenacity of life to play this part. The Lyme grass (*Elymus*) and the Marram (*Ammophila* [*Psamma*] *arundinacea*) soon follow. Round their first scattered tussocks blown sand rapidly becomes heaped up, but the shoots are not easily suppressed, and can be found at depths of many inches, giving rise to new shoots which find their way to the surface. The binding action of these plants gradually increases the size of the dune ridge and makes it permanent. At the same time the plant covering becomes augmented and forms a closer association. The following are the plants of this open vegetation of the loose sand-dunes: *Ammophila arundinacea*, *Elymus arenarius*, *Agropyrum* [*Triticum*] *Junceum* and *Carex arenaria*. These form the dominant group. Additions consist of: *Arenaria peploides*, *Lotus corniculatus* [the Bird's-foot Trefoil], *Ononis repens* [creeping form of Rest-harrow], *Trifolium repens* [a creeping Clover], *Potentilla Anserina* [the Silver Weed, Pl. XII.], *Cnicus arvensis* [a creeping Thistle], and *Glyceria maritima* [a creeping Flote or Manna grass].

"The hollows or troughs between the dune ridges nearest the sea are sandy flats devoid of vegetation and still liable to inundation at high tide. When completely enclosed by protecting ridges, the dune hollows become occasional pools of rain-water where fine dust and organic materials collect. The catch-water has its first vegetation, evanescent growths of slimy blue-green and green algæ, which aid in consolidating the bottom and add to the organic matter, till the soil is impervious enough to retain water throughout the winter and spring. Pools of this kind soon prepare a substratum moist enough for certain mosses, and these in turn prepare a soil dark in colour,

firm and retentive of moisture as compared with the original sand. In time the hollows become covered with a close sward of plants, and form dark green depressions surrounded by sandy ridges as yet only loosely covered with glaucous green sand-building grasses. The later vegetation of the dune hollows depends on the drainage. When this is good, grasses are the dominant element; where water accumulates sedges and marsh plants prevail, and between the two one finds every stage of transition. . . As one passes inland from the dunes, thinly covered with maritime grasses, there is an increase in plants, forming an undergrowth easily distinguished by its fresh green colour strongly contrasting with the glaucous [or blue-green] sand-grasses.

"The more important of these sward-forming plants are: *Festuca rubra*, *Agrostis palustris*, *Glyceria maritima*, *Lolium perenne*, *Lotus corniculatus*, *Trifolium repens*, *Astragalus hypoglottis*, *Ononis repens*, *Erodium cicutarium*, *Equisetum arvense*." *

At a later stage the sward of both ridge and hollow becomes more continuous and contain a much larger introduction of other plants, as four species of clover, the heath and bog, more grasses, two rushes and some sedges, etc. In this list is mentioned a few new plants; one is the All-seed or Flax-seed (*Radiola linoides*). It is the only other genus we have of the Flax family, of which *Linum perenne* is described elsewhere.

It is a minute annual with very fine, repeatedly forked branches. The leaves are opposite. Flowers in clusters very small, and seeding abundantly. It occurs inland on gravelly and sandy places, but is not common, from the Orkneys to Cornwall, *e.g.* near St. Ives, on the hills; and in the New Forest, near Lyndhurst.

* By referring to the index, most of these plants will be found described elsewhere.

RAMBLE XIII

Over a Mountain-Top

All mountains have a special flora more or less distinct from that of the lowlands. Our own are no exception, for we have about ninety species which might be called "Alpine." Many are not to be found in the lowlands at all, and only reappear on mountains of the continent, as the Pyrenees and the Swiss Alps, but also in the Arctic regions, whence they all originally came, when the climate of Europe was universally colder during what is called the Glacial Epoch. As the temperature become milder, these Arctic plants could only find a home on the mountains, the lowlands being invaded by plants of a temperate climate as of to-day.

We will select some of the more characteristic of the Alpine types. The Alpine Meadow-rue (*Thalictrum alpinum*) is a mountain species of a genus of the Buttercup' family, represented in lowlands by the Yellow Meadow-rue (*T. flavum*). It is called "yellow" from the numerous anthers, as it has no corolla, and a very small calyx. The leaves are compound and suggestive in form as of the umbellifers. It may grow to four feet in height, while the Alpine species is only a few inches. This occurs in alpine bogs.

A characteristic genus of Alpine plants is the Saxifrage. They are all dwarf plants; three Scottish species are *Saxifraga oppositifolia*, a tufted plant with bright purple flowers, *S. nivalis*, and *S. stellaria*, with white flowers.

P

There are three species in Ireland: *S. umbrosa*, long cultivated as London Pride, *S. Geum*, very closely allied to it, and *S. aizoides*, with golden-yellow flowers.

The Common Campion and Catchfly have Alpine species, both being tufted, as is the usual feature of mountain plants. The flowers of both are pink. Like so many Alpine plants, the corollas are conspicuous for their brilliancy of colour. Such is a very characteristic feature of Swiss Alpine plants. Of the Blackberry genus there are three mountain species, the Cloudberry (*Rubus Chamæmorus*), the Raspberry (*R. Idæus*), and *R. saxatilis*, growing by sub-alpine rivulets, ascending to 2700 feet in the Highlands, though it is found elsewhere on the west side of England.

A pretty little plant with eight white petals, allied to Potentillas of the Strawberry family (*Dryas octopetala*), has oblong toothed leaves, and grows chiefly on limestone. In Ireland, it is said to descend to the sea-level. Its ally *Potentilla Sibbaldi*, with trifoliate leaves and orange-yellow flowers, occurs up to 4000 feet.

The Gentian has about one hundred and eighty species; numerous kinds will be met with by every Alpine tourist in Switzerland. We have six only, one of which (*Gentiana nivalis*) is found on the Breadalbane and Clora Mountains. One species is named *G. acaulis*, which has been reputed from Wales, but never confirmed. It is a Swiss Alpine species. It most nearly resembles our *G. Pneumonanthe*, which is found in moist heaths (as near Swanage) to Cumberland. The flowers are bright blue and rather elongated, one to two inches in length. It has been noticed that the higher one gets in the Swiss Alps the deeper is the blue of the Gentians, till we reach a tiny species almost on the level of perpetual snow.

A French botanist cultivated some high Alpine plants near Paris, and found the colours became much reduced. The same feature applies to Arctic plants.

Besides the Heaths or Heather, there are three members

Stinking Iris

of the same family found on the Scotch mountains. A species of Bearberry (*Arctostaphylos alpina*)—the name implies that the berries are the food of bears in North Europe presumably, for it is an Arctic plant; *Phyllodoce cœrulea* has no English name and is very rare in Perthshire; and *Loiseleuria procumbens*, formerly called *Azalea*—this is found at a height of 3600 feet on Ben Lomond. It has small pink flowers. The garden shrubs and greenhouse plants, generally known as Azaleas, are now regarded as Rhododendrons; two species occur in the Alps which tourists have probably met with. The plants are small, with rose-red flowers (*R. ferrugineum* and *R. hirsutum*. The genus *Rhododendron* extends from North America—Switzerland—Himalayas—China—Java, to Australia!

Of the Sedge family there is the conspicuous Cotton-sedge (*Eriophorum* (Pl. XXI.)). They are tufted plants with the flowers of spikelets at the top; when in fruit, a number of white hairs form a sort of silky ball, two inches in length. We *had* four species, but the alpine one is now extinct. It grew in Forfar, being only six to ten inches. The commonest is all over the British Isles in boggy places.

Of the true Sedges (*Carex*), of the sixty British species six grow from 3000 feet and upwards on the mountains of Scotland. There are some five kinds of alpine grasses, one of which, the Alpine *Poa*, is almost the same as the seaside bulbous *Poa*, so called because the joints of the stem swell, like the false-bulbs of tropical epiphytic orchids, and for the same purpose of holding water; for the bulbous poa does not form them if plenty of water be in the soil.

Trees on high mountains, as in the Arctic regions, are represented by dwarfs. Thus the dwarf Birch (*Betula nana*, one to three feet high, and a few species of creeping or else very dwarf Willows occurs, such as *Salix herbacea*, ascending to 4300 feet. *S. reticulata*, reaching 3200 feet. The structure of the flowers is much the same as in the Sallow Willow described elsewhere. This dwarfing is a

universal feature in Arctic and Antarctic regions, as well as on mountains. Thus the spruce fir is only about two feet high in the northern regions, the dwarf Birch being one foot.*

Our Scottish Alpine vegetation has been much studied of late; and the distribution of plants into groups or "Associations," according to the nature of their external conditions, has given a clear account of their habits of growth.† A very brief account can be given here. Of course each mountain has its own peculiarities, so that plants which on one mountain do not descend below a certain altitude, may do so to a greater extent on another; indeed, in Ireland they may reach the sea-level. Two thousand feet is taken as roughly indicating the average limit of the Arctic-Alpine types of plants. "Above this the vegetation is characterised by an increase of such plants as saxifrages, dwarf willows with mosses and lichens." Trees cease at that level. The upland moorlands are below that level.

Between the highest enclosed pasture and the Arctic-Alpine zone, there intervenes on most hillsides a zone of heathy moor. This lies on terraces formed during the retirement of the ice at the close of the Glacial epoch. One described at Meall Odhar, eastwards to Lawers Burn, a mile or more in breadth, is characterised by having a wet soil with a so-called "grass" moor, from the prevalence of certain species of grass associated with cotton-sedge (Pl. XXII.) and bogmoss (Fig. 62). Above this comes the true Arctic-Alpine formation. It often happens that one or more species are dominant, and in the high grassland Ben of Lawers it is said that the Alpine species of the

* When some Laplanders came to London they brought a reindeer and a trough full of "Iceland moss." I asked permission to turn it over to look for other vegetation, and I found a complete "tree," one foot high, with roots and stems, but not leaves.

† The student rambler is invited to study *Types of British Vegetation*, edited by A. G. Tansley (University Press, Cambridge), from which I have availed myself of the following observations.

Ladies' Mantle (*Alchemilla alpina*) with silky foliage is in abundance.

The following plants are characteristic: Perhaps as abundant as the preceding is a mountain form of the common Fescue Grass (*Festuca ovina*), being viviparous—that is to say, instead of florets, having stamens and a pistil, leaf-buds take their place—so that when the grass falls to the ground they strike root and so give rise to new plants. This peculiarity is of frequent occurrence on the Swiss Alps, and applies to some sedges as well as grasses.

Two species of the Sedge (*Carex rigida*) and (*C. spicata*) are also present; an Alpine meadow-grass (*Poa alpina*) and a Cat's tail (*Phleum alpinum*), a Mouse-ear chickweed (*Cerastium alpinum*); an Alpine potentilla (*P. Sibbaldi*), with orange-yellow flowers; and lastly, three members of the flowerless Clubmosses (*Lycopodium Selago*, *L. alpinum*, and *Selaginella selaginoides*). These latter plants are now small herbs with closely overlapping tiny leaves. They produce propagative "spores," but have no stamens or pistils. Though they are now insignificant little plants, they are the existing relics of tall trees which flourished in the Coal epoch, at which period no true flowers, as of Dicotyledons and Monocotyledons, were known.

The mountains of Scotland have lately been closely studied as to their floral inhabitants, and the plants catalogued, for different elevations, to the top. We are indebted to Dr. W. G. Smith, of the University of Leeds, for his *Botanical Survey of Scotland*. The section to which we are indebted for the following observations is that headed III. and IV., Forfar and Fife. The Rambler who wishes to study the Flora more deeply than it is possible on the present occasion is referred to that writer's admirable papers, originally published in the *Scottish Geographical Magazine* for February, 1905.

"The Moorland of the Grampians includes both sub-Arctic (*Sub-Alpine*) and Arctic (*Alpine*) forms of vegetation. If the tree limit be taken as the upper boundary

of the sub-arctic region, then it is about 2000 feet—the altitude attained by the Carlochan larch forest. At about 2000 feet a number of the heather-associates become scarce, or cease, while the Blaeberry and other allied species increase in a marked degree. In Forfar, as in Northern Perthshire, the line of 2000 feet on the Ordnance Survey has been adopted as the limit between the sub-Arctic and the Arctic regions. Some elasticity should, however, be allowed, because local conditions of survey are unfavourable to procure definition.

"The heather moor and the grassy hill pasture are the extreme types of the moorland. The vegetation, as one passes northwards and upwards from Strathmore, falls into a series of zones."

The following plants are selected from the list of the "Heather Moors":—

Dominant: Ling (*Calluna vulgaris*). *Sub-dominant:* Blaeberry and Cowberry. *Erica cineria, Empetrum nigrum, Nardus stricta,* Sweet vernal grass, Bracken fern, *Galium saxatile, Scirpus cæspitosus* (a sedge). All these are referred to below.

Twenty-nine lowland plants are given as associates with the preceding; a few are of a more alpine character, as *Alchemilla alpina, Saxifraga aizoides, Arctostaphylos Uva-Ursi, Trientalis europœa.*

Then follows a description of the *Upper Hill Pasture.* It forms a zone above the heather and below the vegetation of the main plateau. "The lower slopes (1500 to 2500 feet) are covered with a close grassy vegetation in which the heather plants are quite subordinate." The following are some of the plants of this zone:—

Dominant: Blaeberry, *Juncus squarrosus,* and the grasses, *Nardus stricta, Deschampsia flexuosa, Agrostis vulgaris* and *Festuca ovina.*

We now reach *The Arctic* or *Alpine Region.* This lies entirely on the Forfar-Aberdeenshire plateau from about 2000 feet upwards to the summit of the highest

mountains, *e.g.* Glas Maol (3502 feet), Tolmont (3143 feet), Broad Cairn (3268 feet), Driesh (3105 feet), etc.

"The chief features of the Alpine region are divided into three groups :—

(*a*) The Breadalbane Mountains, which are grassy with an association of plants hardly differing from the pasture of the sub-Alpine region, except in the abundance of its characteristic species (*Alchemilla alpina*).

(*b*) The second type of mountain is also largely covered with grasses, but with the blaeberry very much mixed with them, and but little heather.

(*c*) The third type is still poorer. Grasses are here relatively rare, and peat plants in contrast dominate. Heather, although abundant, is nowhere in very good condition, and is partly superseded as dominant species by Blaeberry.

"The alpine vegetation of the Forfarshire Grampians belongs to the latter two of the above groups, those in which *Vaccinium Myrtillus* is dominant, with or without *Calluna* [heather, Pl. XIX.].

"The chief factors which determine the distribution of the vegetation are climate and conditions of drainage. The change from the sub-alpine to the alpine vegetation is mainly dominated by climate. The sub-alpine plants extend upwards as far as they can, and their loss of position makes way for those species which are able to maintain themselves under more rigorous climatic conditions.

"*Summit Vegetation.*—On the summits and ridges there is generally an absence of deep peat with its vegetation, while the *Vaccinium* and many of its associates become dwarfed and disappear. The soil is rocky, but is covered here and there by a thin layer of humus, formed chiefly by the decay of the woolly fringe-moss (*Rhacomitrium* (*lanuginosum*) and other dwarf mosses and the lichens (*Cetraria islandica*) and species of *Cladonia*."

On the rocky soil and amongst the humus a few flowering plants withstand alternations of cold and

heat, moisture and drought, and all the extremes of the summit climate. This vegetation occurs about 3000 feet, but on exposed parts it may extend down to the 2700-feet contour line. The following plants are recorded from the summits of Glas Maol (3500 feet), Monega (2917 feet) in Carnlochan, and the Snub and other summits above Clova (2750 feet) :—

Alchemilla alpina, Potentilla sibbaldi, Gnaphalium supinum Lorsileuria procumbens, Empetrum nigrum, Salix herbacea, Juncus trifidus, Carex rigida, Festuca ovina, Lycopodium Selago, L. alpinum.

In addition to this list, another is given of plants growing on Alpine crags and rocks of about fifty plants. It includes four species of Saxifrage, a mountain Bedstraw (*Galium boreale*), the maritime thrift (*Armeria vulgaris*), five dwarf willows, an alpine species of fox-tail and cat's-tail grasses, as well of the Meadow-grass (*Poa*), *Nardus stricta*, and a fern (*Aspidium Lonchitis*) and *Selaginella selaginoides.*

The fern has fronds primately divided and of an oblong form. It occurs from Caithness to North Wales and York (Hooker). The last is the only species we possess of about 150 in the world. This and *Isoëtes*, the Quillwort, of which we have two species, are the only living genera of the family to which they belong. They are the last survivors of numerous plants which existed when coal consisted of flourishing forests. "It now seems clear," writes Dr. Scott, one of our greatest authorities, "that the genus *Selaginella*, or types scarcely distinguishable from it, already existed in the Palæozcic flora, and that it had no near relation to the arborescent *Lepidodendreæ*. On the other hand, there may well be some connection between *Lepidodendreæ* * and the greatly reduced genus *Isoetes*."

Two of the preceding plants require a few remarks as not having been referred to. The Crowberry (*Empetrum*

Studies in Fossil Botany, vol. ii., p. 637.

nigrum) is a small shrubby, heath-like plant, the only species of the genus, there being only three genera in the family, *Empetraceæ*. The parts of the flower are in threes, unusual for a dicotyledon. The flowers are surrounded by scale-like bracts. The sexes are usually on separate plants, but sometimes together; the pistil has from two, three, six, or nine cells, with radiating stigmas. It produces a globular stony drupe. It is an anomalous family; its nearest ally seems to be the holly. The genus *Gnaphalium* is known as the Cud-weed, of which we have four species. They are very woolly little composites. The heads are small in bunches. Plants of another genus, *Filago*, resemble it, but the receptacle is flat without scales in *Gnaphalium*; it is conical with a few scales in *Filago*. A somewhat like difference exists between the wild and the true Chamomile mentioned elsewhere.

We have seen that the Arctic or Alpine region on the Scotch mountains begins at 2000 feet. On descending we enter the tree zone. Taking North Perthshire district as typical, Mr. Robert Smith tells us that "three trees dominate this region, the Scots Pine (*Pinus sylvestris* (Pl. XXXII.)), the Birch (*Betula alba*), and the [introduced] Larch (*Larix europæa*). The Scots Pine is undoubtedly the native tree characteristic of this region, as it grows well in most parts; and remains of its earlier forest are found buried in many peat bogs. The Larch was first introduced into Scotland in 1738, and two of the first trees still stand beside the cathedral at Dunkeld. . . . The plants peculiar to the old pine forests are almost as few and as rare as in the Midlothian district: *Linnæa borealis*, *Pyrola minor*, *P. media*, *P. rotundifolia*, and *P. secunda*, *Trientalis europæa*, *Corallorhiza inata*, *Listera cordata* [*Moneses grandiflora* and *Goodyera repens*, only elsewhere in Perthshire].

RAMBLE XIV

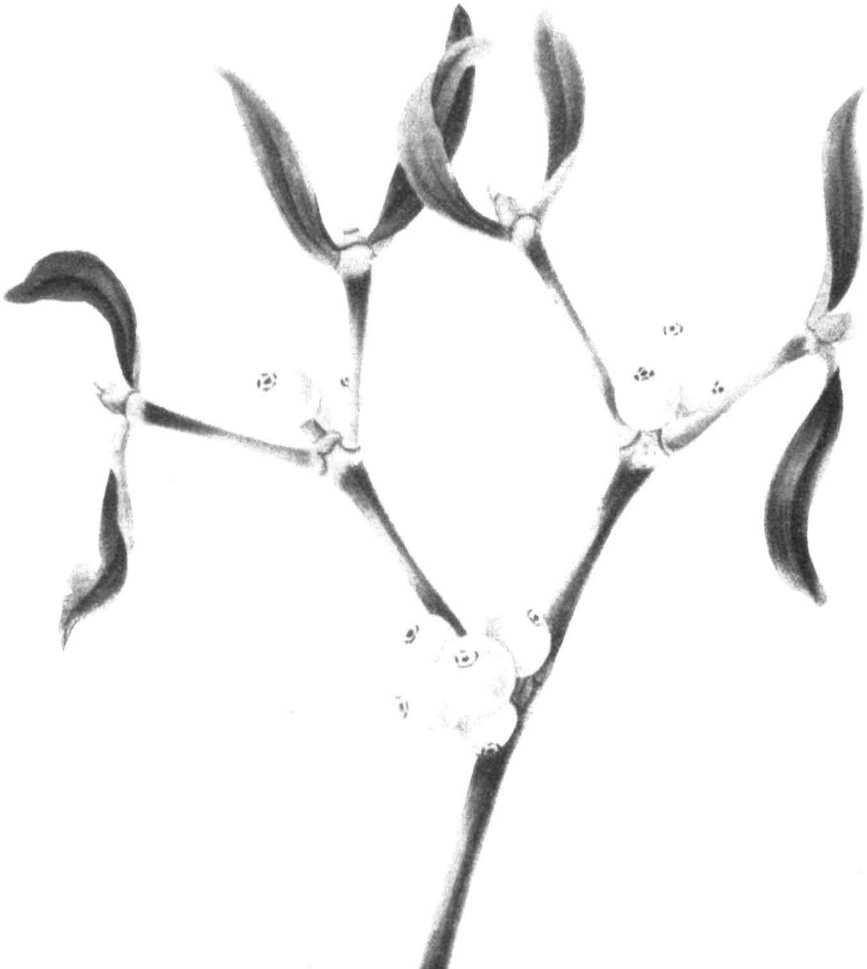
Through Woodland

Many herbs and shrubs, as well as trees, make the vegetable population of woods and copses. Let us consider the herbs first. Perhaps the most striking is the Blue-bell in spring (*Scilla nutans*). The "sheets" of blue, as has been suggested, look like a piece of heaven on earth! We often call it the wild hyacinth, but it does not belong to that genus; for the six parts of the perianth are all free, and not coherent into a tube as in the foreign or garden hyacinth. The medicinal Squill of South Europe is of the same genus, *Scilla*, which supplies the name. It has a huge bulb about four or five inches in diameter. It is not uncommon in Malta. One, stowed away for more than twenty years in the museum of St. Bartholomew's Hospital, began to grow, but soon died.

The bulb of the Blue-bell is very acrid, probably containing a similar property to the Squill.

As soon as the Blue-bells are over, the copse may be almost as uniformly red. This is due to the Red Campion (*Lychnis diurna*), allied to the Ragged Robin, another species, but frequenting meadows rather than copses. They belong to the Pink family.

A curious little Umbellifer (*Sanicula europæa*) is common, growing to about one to two feet high; but unlike the Carrot and Parsnip, it has not the umbrella-like stalks, the little pink flowers being clustered into a globular head, somewhat resembling a composite; the



structure of the flower, however, at once reveals it to be an umbellifer.

The Yellow Pimpernel (*Lysimachia nemorum*) is a smaller-flowered kind of the same genus as the familiar Creeping Jenny, so often grown in vases, etc., for its long slender stems and golden flowers. It is similarly "procumbent," but is not so conspicuous. It belongs to the Primrose family. Though called "Pimpernel," the latter belongs to a different genus, known as the Poor Man's Weather Glass or Scarlet Pimpernel (*Anagallis arvensis*).

The Primrose and Oxlip, which supply the family name, both being of the genus *Primula*, are found in woods, but their ally the cowslip is fonder of open ground. The Primrose (Pl. XXII.) flowers usually arise singly from the ground, the common stalk, seen in the cowslip, being very short; but it occasionally is present, and the cultivated *Polyanthus* is derived from the stalked form of the primrose.

As to the Oxlip, it has been debated whether it be not a hybrid between the primrose and cowslip, the flowers being somewhat intermediate between those of the other two species.

Of the small and larger-flowered Periwinkles cultivated in our shrubberries, the former is a truly wild species (*Vinca minor*), the larger is considered as naturalised, having been introduced from the Continent. The branches of the smaller kind are prostrate and give off roots; but the larger sends out long arching shoots which only root at the tip, reminding one of the blackberry in this respect.

The Wood-ruff (*Asperula odorata*), so called because, on drying, it is sweet-scented with the odour of hay. It is a familiar plant, being often cultivated. Like the Bedstraw (*Galium*) it has leaves in whorls, and clusters of small white flowers, the parts of which are in fours, except the pistil, which has two carpels. The name was curiously

spelt in the Middle Ages—Wodde-rowffe—the two halves of the name making a rhyme.

The Wood Anemone (*Anemone nemorosa*) is an old favourite; the flower has no corolla, the white or bluish-coloured whorl is the calyx. Like the buttercups, belonging to the same family, *Ranunculaceæ*, it has numerous stamens and carpels. It may be occasionally found "double," when the stamens are replaced by petals.

There is a species of buttercup only found in woods and copses, called Goldielocks (*Ranunculus auricomus*); it has orbicular leaf-blades more or less divided. The flowers are more often with less than five petals; it has, then, been called var. *depauperatus*. The interesting feature about it is that some stamens have passed into an imperfect condition of petals, the anthers being open at the top, while the front and back form yellow flaps; this represents the preliminary stage of a petal of an ordinary buttercup, the outer flap developing into the so-called petal, while the inner remains rudimentary, between the two being the honey-pit. This condition as a "nectary" * is more perfectly seen in the Hellebore and Winter aconite.

There are two plants we often grow in our gardens, the Lily of the Valley (*Convallaria majalis*) and the Solomon's Seal (*Polygonatum verticillatum*). They are both woodland plants. The latter is rare, occurring from Northumberland to Kent and Devon, but not to Wales (Hooker); it is elsewhere naturalised. It has a stem two to three feet high, arched with rather large leaves, three to five inches long. The flower stalks bear about five pendulous flowers, of a tubular shape and greenish-white in colour.

The Lily of the Valley is too well known to need description. Both have creeping stems, and not bulbs, as is commonly the case with members of the Lily family, to which they belong. They both bear red berries and are poisonous plants.

* This is the botanical term for parts of the flower which have been altered to secrete the honey or "nectar."

The Star of Bethlehem (*Ornithogalum umbellatum*) and two other species are found in copses. The first has its flowers in umbels. The "French Asparagus" (*O. pyrenaicum*), a native of Somerset, Wilts, etc., is sold in Bath before the flower-buds are open, under this name.

The Wild Strawberry (*Fragaria vesca* (Pl. XXIV. and Fig. 92)) is a familiar little plant with trifoliate leaves and white flowers, and scarlet or crimson "fruit," though the edible part is really the globular receptacle, similar to that of the buttercup (Fig. 1). The fruit consists of the collection of seed-like achenes scattered all over the surface. That they were carpels is proved by the presence of their

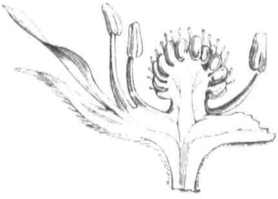


FIG. 92.—Strawberry.

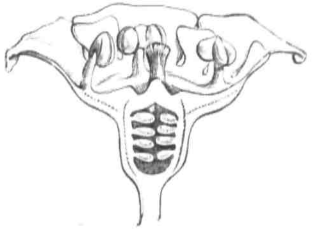


FIG. 93.—Section of the Flower of Currant.

dried-up styles. Fig. 92 shows the structure of the flower. It has a thick receptacular "disk" which carries the sepals, petals, and stamens and secretes honey all round the base of the pistil. (Figs. 1–4, Pl. XXIV., explain themselves.)

The Gooseberry and three species of Currant, all belonging to the genus *Ribes*, occur in woods, and are the origins of our garden fruit.

Fig. 93 shows the structure of the flower of the currant. The saucer-like summit *above* the ovary is the receptacular disk spreading out from the summit of the ovary, and carrying the five sepals, petals, and stamens on the margin. There are two carpels, as shown by the two stigmas, as well as by the two groups of ovules, on opposite

sides of the ovary when divided across the middle. These two halves correspond to the two carpels, like two leaves put face to face and united along the margins, which now swell up to increase the surface for bearing ovules. The ovary is clearly "inferior."

The pulp inside a gooseberry is not made from the carpel as in the plum; but each seed is enveloped in a coat of pulpy matter, so that the whole of the seeds become embedded in the united mass of pulp.

The Foxglove (*Digitalis purpurea*) is almost ubiquitous, but is scarce in East Anglia. The arrangement of the stamens and pistil for pollination agrees with that of the dead-nettle, already described; but the humble-bee creeps *into* the tube of the corolla. Of the four stamens, the latter pair shed their pollen first, then the shorter pair, and both before the stigmas are ready to receive it. If bees are scarce, it is of no consequence, for the pollen remains in the open anthers, and, as they stand *above* the stigmas, since the corolla is pendulous, and therefore upside down, when it falls off it drags the anthers over the stigmas, and so pollinates them. It always sets an abundance of seed.

The Wood Betony (*Stachys Betonica* (Pl. XXV.)) is a frequenter of copses, woods, roadsides, etc. It has a stem 6 to 24 inches in height. Its flowers are grouped and are oblong, long-stalked spikes, 1 to 3 inches in length, the corolla being red-purple. Though bitter and capable of dyeing wool of a fine dark yellow colour, the root does not appear to have all the virtues with which the plant was formerly credited in the Middle Ages, being a supposed remedy for many things. One recipe of the fourteenth century runs as follows: "*Ad purgandum hominem de malis humoribus.* Take betoyne [betony] and sauge [sage] and Synsiburium [ginger] of eche y-liche [alike] moche, and do thereto piper [pepper] and hony and stampe hym [them] and tempere hym wyth wyn [wine] and yef [give] the seke [sick] to drynke."

Another plant of the same family of Labiates is figured on the same plate, and also occurring in copses, etc., the Wild Basil (*Calamintha Clinopodium* (Pl. XVI.)). It is a softly hairy plant, with a purple corolla.

A curious leafless parasite abounds where hazels occur in woods. It has white or pale purple scales, and is parasitic upon the roots of the nut bushes. It has a thick underground scaly rootstock, attached by tubercules to the roots of its host. It grows to about ten inches in height. The structure of the flower agrees with that of other members of the Foxglove family (*Scrophulariaceæ*) to which it belongs, though it has acquired the above "degraded" structure through parasitism. Its name is the Toothwort (*Lathræa squamaria*).

The Tway blade (*Listera ovata* (Pl. XXVI.)) is an orchid, easily recognised by its two broad leaves with curved veins, and a slender stalk bearing small green flowers. The "lip" is long and narrow, and bears a honey-groove, which flies crawl up and suck; and when they reach the top and touch the pouch at the foot of the pollen-masses, some gum exudes and sticks the pollen to their heads. By this means they pollinate other flowers.

The Helleborine (*Epipactis latifolia*) is not an uncommon woodland orchid. It has a very leafy stem one to three feet high; the leaves are very variable in their width. It bears racemes of greenish-purple flowers, while the White Helleborine (*Cephalanthera grandiflora*) has white flowers. It especially favours chalky districts. Lastly, the Butterfly Orchis. The flowers are almost an inch long, white, with a green tinge. It is sweet-scented.

The Daffodil is also a copse plant, though it occurs also in pastures. It has produced several varieties. It is a poisonous plant, as children have died from eating the flowers.

The Butcher's Broom (*Ruscus aculeatus*) is somewhat rare in copses. It is a shrubby plant growing to about two feet in height, and remarkable for having two kinds

of stem and no leaves; the main one is cylindrical, but the branches are flattened out and shaped like, and do duty for, leaves; but the flowers and berries stand in the middle of this flattened branch, showing that it is not really a leaf. This is the only British Monocotyledon with a *woody* stem; though the wood-fibres are not in concentric cylinders, as in ordinary dicotyledons, but scattered, as in all monocotyledons, forming isolated cords in the general soft, cellular tissue, just as in an asparagus stalk, which is closely allied to this plant. The flowers of the Butcher's Broom have their sexes on different plants.

Another plant also allied to the preceding, both of which belong to the Lily family, is the *Maianthemum*. It is not at all common, but occurs in the woods of Yorkshire and Lancashire. It has long been cultivated in gardens. It has underground creeping stems, and not bulbs as so many of the Lily family possess. It has small racemose and white flowers.

Ramsons (*Allium ursinum*), a kind of onion, is a copse plant having a bulb. The leaves are from four to eight inches. It bears an umbel of about a dozen white flowers.

The name is derived from the Anglo-Saxon word *hramsa*, rank, from its strong onion-like smell. It was formerly eaten, as the old couplet says—

> "Eat Leeks in Lide [March] and Ramsons in May,
> And all the year after physicians may play."

The Wood Sorrel (*Oxalis Acetosella* (Pl. XXVII.)) is a delicate, white-flowered little plant with trifoliate leaves. These, like clover, "sleep" at night. During the day the three leaflets are horizontal, but when it sleeps they fall down; each leaflet has its halves more or less pressed together, backing against the stalk, as shown in the illustration. In clovers the two lateral leaflets twist till they are erect, then they place their upper surfaces together, finally the terminal leaflet swings right over and forms a

roof over the other two. The object of sleeping is to place the blades vertically, and to protect, especially the upper surfaces, against injury by radiation of heat at night.

A similar protection occurs with many leaf-buds in spring when they open. The reader should examine the half-expanded leaflets of roses, laburnum, ash, horse-chestnut, and lime as interesting cases.

The stamens of the Wood-sorrel will be seen to be ten in number, in two sets of different lengths. The five styles of the pistil correspond with the taller stamens in the figure; but in other specimens they will be found to be short and of the same height as the shorter. The result is probably the same as in the purple Loosestrife; only that has *three* sets of stamens and styles as described.

There is an interesting species, native of the Cape of Good Hope, having a tall flower stem and rather large drooping yellow flowers, like the cowslip. Besides setting seed it propagates by tiny bulbs about half an inch in size. A few of these were sent to Father Giacinto, the teacher of botany in Malta, in 1804. He planted them in the garden of the medical school. Only the *short* style plant is known; but it has spread all over Malta and Gozo, and, through the exportation of orange trees, it is found at various places from Egypt to Morocco, and from Gibraltar to the Greek islands, being propagated solely by means of bulbs, as the kind corresponding to the short style is not known in Malta and elsewhere. I have found this *oxalis* growing in a private garden in the Riviera, and abundantly in Egypt.

The late Dr. Sickenberger, the teacher of botany in the schools of medicine, Cairo, received an aloe from the Cape; from the soil there came up a plant of the *long-styled* form; probably the only one in the northern hemisphere!

Another peculiarity of our British species of Wood-sorrel is that, besides the flowers, it produces self-fertilising bulbs

(*a*, *b*, *c*, *d*). These never open, like those of the violet developed on the shoots under the leaves, *after* the non-seeding scented ones are over. They are called *cleistogamous*,* a word meaning "concealed-union," *i.e.* of the pollen and ovules.

One of the commonest herbs, already alluded to in our Chalk Rambles, is the Dog's Mercury (*Mercurialis perennis* (Fig. 81)), but it is often seen on shady banks and in woods. The sexes are separate on different plants. It belongs to the Spurge or *Euphorbia* family. It has opposite leaves. The male flowers consist of calyx of three sepals and nine stamens, while the female has two filaments without anthers, called "staminoids" and a pistil of two carpels, as shown by the spreading styles.

There is a small annual species found more especially in the south of England. It is abundant at Hythe (Sussex), and I have found it at Bath. It is very abundant in Malta.

The former species has proved fatal to sheep, and the latter to human beings, who had made soup from it.

Two somewhat rare plants, but both cultivated, are to be found by those who ramble in the west and north of England. One is the Globe Flower (*Trollius europæus*), so called because the sepals and petals, sometimes thirty in number, form a rather globular flower one and a half inches across, the stem growing to two feet in height. Hooker gives the distribution as sub-alpine pastures and copses from East Cornwall, Worcester, and Wales, to Shetland. It occurs, for example, in Bolton Abbey wood. Besides the Aconite, mentioned elsewhere, there is still a third of this group belonging to the Buttercup family, the Bane-berry or Herb Christopher; it grows in copses in Yorkshire and Westmorland. The stem is

* Pl. XXVII.
1. Flower with calyx and corolla removed.
2. Cleistogamous flower-bud.
3. Petals, spirally wrapping the stamens and pistil.
4. Anthers of taller stamens adpressed to short stigma.
5. Fruit, with sepals remaining.

Mezereon.

two feet in height. It bears racemes of small white flowers, and produces nearly black berries, which are very poisonous.

A curious little herb, the Herb Paris (*Paris quadrifolia*), is to be found in woods "from Caithness to Kent and Somerset," but only locally. It has usually four leaves, but ranging from four to nine, in a "whorl;" the flowers look green, though the petals are slightly yellowish. It produces a black berry. Like many monocotyledons, it is poisonous in all its parts. Its leaves are remarkable for being "net-veined" like any common dicotyledon, and not "parallel-veined" as is usual in monocotyledons.

We have two British species of *Iris*, the common yellow-flowered Flag, growing in water, and the Roast-beef plant or Fœtid Iris, having a blue-purple colour, to be found in copses and hedges, but sparsely (*Iris fœtidissima* (Pl. XXVIII.)). The name is suggested by the peculiar odour of a bruised leaf.

The flower of an Iris has six perianth leaves, three down and three erect. There are only three stamens, one above each pendant leaf. In the middle is the column of the style and stigmas; the three stamens are erect against it, the anthers bursting outwards. The stigmas consist of a little ledge just over the stamen, the upper part being prolonged into a petal-like flap. The honey is secreted in pits, one on either side of the filaments. It is easy to see how all the above are in adaptation for pollination by insect visitors.

We must not forget the Mistletoe (*Viscum album* (Pl. XXIX.)), parasitic on various trees, but most rarely on the oak. The reader can recall the white berries, which contain a glutinous juice, so that thrushes, etc., rub their bills on the boughs to get rid of the seed, which sticks to it. It sends out a root which always turns to the darker side, *i.e.* to the bough, and penetrates through the bark, and then grafts itself on to the growing tissues below. Having green leaves, it can derive food from the

air (carbonic acid gas) as well as nourishment from its host. As plants growing on the ground produce varieties by the seeds germinating in various soils, so the Mistletoe has varied by growing in different trees. There are foreign species besides our own *Viscum album*.

One more herb. It grows in a wood at Church Stretton, Shropshire, and near Malvern, and nowhere else, but it has been noticed that the places are old limestone quarries worked by the Romans. It is called *Astrantia major*. It is a native of South Europe, and an umbellifer, but has only a simple umbel, so that the flower-stalks only radiate *once* from the main stem, not *twice* as is usually the case. The stalks are surrounded by bracts of a greenish white and pink colour. It is a very old garden plant. The suspicion as to its origin near Ludlow and Malvern is that the seed was accidentally brought by the Romans from South Europe.

FIG. 94.—Spurge Laurel.

There are two species of the genus *Daphne*, consisting of small bushy plants. One is the Spurge Laurel (*D. Laureola*) with green tubular flowers (Fig. 94), as there is no corolla. The other is the Mezereon, with a rose-coloured calyx, and is often cultivated (*D. Mezereum* (Pl. XXX.)). Both have berries which are poisonous.

There are three species of Lime tree described by botanists, but only one appears to be certainly a native (*Tilia platyphyllos*), the Large-leaved Lime. Hooker considers it a native in woods of Hereford, Radnor, and West York. It is a tree growing to ninety feet in height. It differs but little from *T. parviflora*, growing in woods from Cumberland

southwards. The common cultivated Lime (*T. vulgaris*) is not indigenous.

The form of the leaf is called "oblique," for one half has a shorter basal part than the other. It is interesting to observe the buds as they open in spring. The bud-scales are really stipules, and as the bud elongates it bends downwards; the young leaves have the two halves folded together, called "conduplicate"—as occurs in many other trees and herbs and hang vertically downwards. Their stipules are rather long, scale-like structures, which are horizontal more or less, protecting the undeveloped leaves.

The reason for this is that it is most important to protect the blades from chill, as radiation of heat from a vertical surface is less than from a horizontal one. And it appears that the *upper surfaces* of the blades are more sensitive, so they are always folded one against the other. As soon as the blade is full grown they rise up again and spread themselves out horizontally. The cause of the obliquity of the base of the blade is due to the position in the bud with respect to the stipules; one edge has a little more freedom for growth than the other in the bud.

The flowers of the Lime are simple. There are five free sepals and petals, many stamens, and a pistil of several cells. The honey is lodged in the sepals, which form little boats to receive it. The fruit never appears to ripen its seed in this country—that is, of the common imported tree (*T. vulgaris*).

The Buckthorn family is represented by two species of *Rhamnus* (*R. catharticus* (Fig. 79)); and *R. Frangula*), both occurring in woods; they are shrubs about ten feet in height or less. The Common Buckthorn has minutely-toothed leaves; the other species, called the Alder Buckthorn, has "entire," *i.e.* smooth-edged leaves. The flowers are small, the calyx having four or five points. The petals are also very small; yellow-green in colour. The stamens stand in front of, or, as the botanists say, opposite

to, the petals, instead of alternating with them. This is a rare condition, occurring as described in the case of the cowslip and primrose. The interpretation is that there ought to be two whorls of stamens, the outermost, opposite the sepals, being wanting.

The berries are black and injurious. Children have suffered severely from eating them. On the other hand, they have an important use for dyeing purposes, yielding both a saffron colour and the "sap-green" of painters. The berries of our English species (*R. Frangula*) when unripe dye wool both yellow and green, but when ripe both blue and green.

One species (not indigenous) called *Cascara Sagrada* is used in medicine, but all species are purgative.

The familiar Guelder-rose (*Viburnum Opulus*) of our garden shrubberies, with its great globes of cream-white flowers, originated from a wild source of our woods.

The "trusses" of flowers are unlike those familiar white globes of our gardens, for the latter have all the middle flowers transformed into others, like the circumferential ones. The former has a small corolla, with stamens and pistils. In the latter these are wanting, while the corolla is greatly enlarged to about three-quarters of an inch in diameter. This renders the trees conspicuous to insects, as there is plenty of honey ready for them in the middle flowers. In the garden form, all the flowers being neuter or barren, no seed can be set. It has scarlet berries.

The Wayfaring Tree (*V. Lantana*) is another species of the same genus. It occurs in hedges as well as copses; the leaves are not smooth but downy. The flowers are all perfect, and it bears clusters of black berries. These belong to the same family as the Honeysuckle and Elder.

There are several trees belonging to the Rose family in copses and woods. Species of Plum and Cherry (*Prunus*), of the Pear and Apple, as well as the Service, White Beam, and Mountain Ash (*Pyrus*). These have, by cultivation,

provided us with several kinds of fruit. Thus a variety of the Sloe is known as the Bullace, but the Wild Plum, however, is not really indigenous; the Wild or Dwarf Cherry is the source of the Morello, Duke, and Kentish Cherries (Hooker); another species is called the Gean; all these are species of *Prunus* (Fig. 3).

The genus *Pyrus* gives us the Wild Pear and the Wild or Crab-apple; these appear to have been the sources of the innumerable varieties of cultivation.

It will be observed that this latter group of fruits differ from the former, which are simply succulent pistils with a stony lining, the kernel being the seed; whereas in pears and apples, as well as quinces and medlars (though the latter is occasionally wild in hedges and copses, but not indigenous), the separate carpels are sunk in a massive cup made out of the stalk and united with it. They may be compared with a rose-hip (Fig. 2), which is a similar structure, but hollow, and *not* adherent to the seed-like fruits within it. Hence the edible part is really *stalk*, and not *fruit*, as in the plum and cherry.

The Hawthorn berry is of a similar structure to all the members of the Pear genus, such as the Mountain Ash. This has consequently nothing in connection with the Ash tree, only the leaves made of two rows of leaflets resemble those of that tree; this may be frequently seen growing in hedgerows as well as copses. The fruit of the Ash roughly resembles a bunch of keys; hence the popular name; each fruit is "winged," so the wind can convey it to some considerable distance.

The "Cup-bearers," as we may call the Cupulifers, form a group containing the Birch and Alder in one section; the Hazel and Hornbeam in a second; and the Oak and Beech in the third. These six are the British representatives of the family. They have generally some sort of envelope made of bracts surrounding the fruit; it is a hard and woody cup in the Oak and Beech, but leafy in the Nut and Hornbeam.

Taking the Hazel (*Corylus Avellana* (Pl. XXIX.)) as a type, each staminate flower has only a bract, all together forming a long catkin. The female flowers consist of a little cone-like body, made up of bracts with a pistil having its styles extruded with crimson stigmas, which are pollinated by the wind.

Nuts have varied in form under cultivation; so that we have the long sorts or filberts and the globular cobs. There is no endosperm surrounding the embryo, so that this is the edible part as it is in an almond, peas and beans, whereas in wheat it is the endosperm which makes the flour.

Now let us consider the larger trees which form copses and woods. There are three kinds which give their names especially to woods, Oak-, Beech-, Ash-, and Pine-woods, as forming the great bulk of the timber respectively.

We have two principal varieties of the Oak; the one has the acorns on very short stalks, on the other they are elongated. Conversely, the first has stalked leaves, in the latter there are no stalks.

With regard to the shape of the leaves, they all have a very wavy outline, but there may be extraordinary differences in the depths of the depressions, sometimes almost reaching the " midrib " of the leaf.

The flowers are male and female on the same tree. The " catkins," consisting of male flowers, are composed of a calyx with many stamens; the female is a cup-like mass of bracts which hardens into the " cup," and a pistil of three coherent carpels with six ovules, two in each cell; but as a rule only one seed is developed in the fruit or acorn.

Oaks are remarkably liable to produce " galls," after the puncture of an insect to lay its eggs. Sometimes only one grub is to be found inside, but in " oak-apples " they are numerous. The " galls " are usually globular, but tiny ones are flattened on the leaves and called " spangles." The development of galls is a response to

the irritation set up by the presence of the egg and grub, and is formed by a great increase in the quantity of cells which would otherwise form the usual layers within the leaf or shoot. They thus supply board and residence for the tenant, until it is developed into a flying insect, when it bores a hole through the gall and escapes.

Oak bark and wood make a good deal of tannic acid, a substance which sometimes makes tea so astringent. Hence the galls were collected for making ink; since tannic acid with a salt of iron as "green vitriol" gives a black solution. It is this which makes "bog oak," that is, logs of oak trees found buried in old peat bogs, of a jet black colour, as iron is a common mineral in soils.

There are about three hundred species of Oak; a European one, the Cork Oak, has a thick bark which supplies us with corks for bottles, etc.

There is an interesting tree growing in the woods of Killarney called the Strawberry-tree (*Arbutus Unedo* (Pl. XXXI.)). It belongs to the Heath family. It grows to about ten feet high and produces clusters of creamy white, bell-like flowers, and bears berries two-thirds of an inch in diameter, of an orange-scarlet colour covered with little roughnesses. The berries are edible when perfectly ripe, and are made into wine in Corsica.

It is another of the small group of plants only to be found in the West of Ireland, their former home being Southern France and Spain.

The Scotch Fir or Scots Pine (*Pinus sylvestris* (Pl. XXXII.)), as it is now called, is a familiar tree all over England, but is native only, Hooker says, "in a few spots from York to Sutherland; ascends to 2200 feet, once native of many parts of Britain; planted elsewhere"—as at Bournemouth—from 1815 onwards. It sheds its bark, like the plane, leaving the tissue underneath it of a red colour.

The flowers are male and female; the former consist of short catkins (left-hand illustration) of yellow scales

pointed above, bearing two anther-cells (1). The females consist of a bract with a so-called carpellary-scale (2, 3), because it bears two ovules (2); these are quite naked and exposed to the air, as the scales do not close up while the ovules receive the pollen when wafted to them by the breeze. Then the scales close up for two years (right-hand illustration), developing thick, corky tips.

If a seed (4) be examined internally, it will be found to contain a mass of white tissue, the endosperm, containing starch, etc., stored up in the cells for the use of the embryo within it on germination. The embryo is remarkable for having a number of seed-leaves or cotyledons, and not merely two, as is characteristic of Dicotyledons.

If young seedling conifers be examined, the little "trunks," three or four inches high, will be found to have a perfect and strong cylinder of wood, very unlike the stem of a herb, which has only a circlet of quite distinct and separate woody bundles of fibre. This shows the effect of heredity of acquired characters, for the trunk of a tree is the result of a response to gravity to enable the tree to withstand the incessant pull to make it fall. So the seedling begins to make a trunk—though needless at the time—in anticipation of its future requirements.

The woody carpellary scales are curious in possessing remarkable hydroscopic properties. The knobs at the apex are constructed of cork and readily imbibe water, so that when the ovules have been pollinated, the knobs, being now supplied, close up over the previously exposed ovules. When, however, the seeds are ripe, the cone becomes dry, and, having lost their water, the carpellary scales all spread out to liberate the winged seeds—the wings carrying them, by the aid of the wind, to considerable distances.

If now the cone, which has fallen off the tree, be put head downwards in water, though quite dead, the knobs reabsorb water and the scales all close up tight. When, however, they become dry they all reopen as before; but

Strawberry Tree.

while it takes half an hour or less to close them, it requires a much longer period to reopen them.

A few herbs are characteristic of Pine woods, but the fallen "needles" make the ground very unattractive to many herbs, though the Bracken fern can flourish by burrowing in the under soil with its creeping stems. There is an orchid (*Goodyera repens*) growing to eight inches or so, with cream-white flowers. It is a rare plant, to be found in East Scotland and southwards to Cumberland. *Listera cordata*, like a miniature Ivy-blade described above, is common in woods.

Linnæa borealis, named after the great botanist, Linnæus, is a creeping evergreen shrublet, bearing two-flowered stems. The corolla is somewhat bell-shaped with five pink, sweet-scented lobes. It belongs to the same family as the honeysuckle.

There are four species of Winter-green (*Pyrola*) which occur in Pine woods; they belong to the Heath family. They have radical, evergreen leaves. The flowers are in racemes, pinkish white or yellowish in colour.

The Chickweed-wintergreen (*Trientalis europæa*) is a local plant of the Primrose family, found in sub-alpine woods from York to Shetland. The leaves are arranged in whorls of five or six. The corolla is flat with five to nine petals.

A Rest; and Reflections

On Evolution by Self-adaptation, etc.

General Observations.—The results of our study of wild flowers while rambling here, there, and everywhere, may be described as the Study of Geographical Botany on a small scale; for this high-sounding term would include rambles in foreign countries all over the world; but, as the external conditions of life are fundamentally the same as in Great Britain and Ireland, only differing in degree, the results are the same, only being proportionally different according to differences of climates, etc.; for, taking water, heat, light, and soils as the main external factors, we have the *maximum* of water with submerged plants; but we do not get the *minimum* in this country; for that we have to study the vegetation of the great deserts, as of Mexico, North and South Africa, Australia, etc.; but just as our stone-crop or the tops of dry walls produce fleshy leaves wherein to store water, so gigantic members of the Cactus family have huge stems full of water, their leaves being reduced to spines. Precisely similar stems occur in the Spurge family in Africa; for, whereas our species are insignificant weeds, in South Africa the stem mimics those of the Cactus family of America. Again, our terrestrial orchids have small tubers underground, but tropical, epiphytical orchids grow high up on the boughs of forest trees, and get but little water, so that the internodes of their stems have swelled into

miniature tubes of water, called "pseudobulbs." The outer coat is excessively tough and impervious to water, but the cellular tissue or pith is thin-walled and full of it, as a provision against excessive drought.

Similarly in the cases of great heat and great cold; we do not suffer from extremes, yet we find differences in the plants of lowlands from those on the tops of our mountains. These differences are accentuated when we study tropical floras and those of the Arctic and Antarctic regions; yet one common principle of development rules the whole of the floral or botanical world, namely, self-adaptation to the environment; *i.e.* the power to respond to the external conditions of life—within limits—is the clue to the origin of the multitudinous forms in the vegetable world.

The proofs of this ready response we have seen in the constant production of new forms of plants envolved in our kitchen and flower-gardens, as well as in agriculture. Many have so changed in the course of ages that the original plants are unknown and untraceable, as most of our cereals, and Indian corn, as well as of many fruits, etc. Few or no wild plants known suggest the primeval species from which they have descended.

It has been thought by some that our Wild Oat (*Avena fatua*) might have been the origin of the cultivated kind, but others think it to be doubtful. But the wheats, however, seem "now to have been traced to four primitive types, according to Dr. Stapf, of Kew; the most important of the wild species (the original of the hard wheats and other forms) has only been recognised within the last few years as a weed growing on the slopes of Mount Hermon, in Palestine; the wild form of the soft wheats is still unknown." *

This means that the wild plant when cultivated adapts itself to the new conditions of the soil, and develops the

* Quoted from Dr. H. H. Scott's *The Evolution of Plants*, an admirable account of the evolution of seed plants (Gymnosperms) from fern allies of ancient times.

new form, which after several generations becomes relatively fixed.

Not only may *one* kind of plant change in some special ways, but *many* totally different kinds or species of different genera of different families may do so too.

Mimicry in Plants.—This remarkable feature of mimicry in the forms of certain plants has often been noticed. It is especially prominent in plants of excessive drought, as in deserts, or of aquatic plants, so that members of one family almost exactly imitate in structure those of another in a far distant country. Thus the "American Aloe" of Mexico, a member of the Daffodil family, and widely grown, not only in England, but as is so often seen in blossom in the Riviera, produces a gigantic flowering stem, twenty or more feet in height—as far as the thick, massive, pointed leaves can do it—exactly resembling the true Aloes (in Latin, *Aloë*) of Africa of the Lily family.

Again, the needle-like leaves of Heaths have several imitators among other families at the Cape, like the Juniper in England.

One of the most universal forms of mimetic leaves is found in plants of a very dry character; for it occurs in heath plants as the Ling (*Calluna vulgaris* (Pl. XIX.)), in mountain herbs, as Club-mosses (*Lycopodium* (Fig. 95)), a flowerless genus propagated by spores; and in numerous flowering plants, as an umbellifer (*Azorella* (Fig. 96)), in Alpine Veronicas of New Zealand, in Thuyas of our shrubberies, etc. The minute and closely compacted leaves are so deceptive that without the flowers it is impossible to refer such a plant to its right family.

Spinescence is a prevailing feature in many drought plants, as seen in our Furze and Needle-furze, belonging to two separate genera. As explained above, it has been proved by experiments that it is caused solely by drought, and may disappear when plenty of water is present. As Darwin says, they are "the result of the direct action of the conditions of life." And he adds, that if many

seeds of the same plant be subjected to similar conditions, and they all put on the same features in response to them, then a "new variety will arise *without* the aid of natural selection."

A like mimicry in another form is seen in aquatic plants. There is no doubt about the fact that the Water Crowfoot was descended from some terrestrial species of

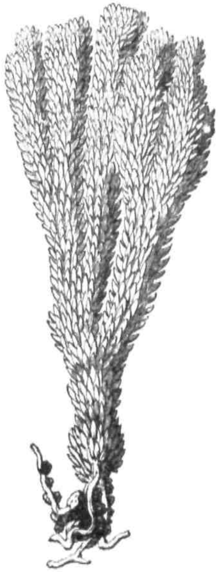


FIG. 95.—Club-moss.

FIG. 96.—*Azorella*.

Buttercup, but we have seen how the deteriorating effect of water prevents the plant from developing ordinary leaves, so that the submerged foliage is always finely dissected; but, as was shown, if nutritive salts are supplied, so as to strengthen the protoplasm, then full-sized leaves will be developed under water.

Now, many families, mostly terrestrial, have one or

more species aquatic; when that is the case, the general rule is that the submerged leaves are dissected; some few take on a ribbon-like leaf, and this, too, has its unrelated imitation, not only among Dicotyledons, but with all Monocotyledons, which have descended from aquatic Dicotyledons.

Hence, mimicry of the vegetative structures is simply the result of like external conditions, so influencing plants that they respond to them in identically the same way, and mimetic forms are the result. The object of the thick foliage of aloes is that of water-storage; whereas the excess of water produces degradation in aquatics.

An analogous result occurs with flowers. Insects which now visit flowers find them prepared to receive them in certain special ways. Thus, a regular flower is terminal, and is visited from all points of the compass, so no one or more petals differ from another, as in buttercups; but when the flowers are close to the stem, as in Labiates, then the corolla, as we have seen, is *adapted* to the insect in so many details that the only interpretation is that the form is the result of some process of response to the mechanical influences brought to bear upon the flower when the insect visits it for honey.

As another instance of mimicry, we have seen that tendrils may be made out of leaves usually, but also of flowering branches, as of the vine, but always in response to contact with some object to which they can attach themselves.

Hence the general conclusion is *forced* upon our acceptance that all structures are the result of two things —the external conditions of life, and a power of response in the life of the plant itself.

Life is, as Sir Oliver Lodge says, a "Director of Forces"; and under that "Directivity" all kinds of *purposeful* structures are made.

Mutual Adaptations.—A feature in plants we have found illustrated might be called *mutual adaptations*

between plant structures. That is to say, one "organ" can take the place of another if Nature requires it, or supplement it in some other way. Thus in terrestrial plants, water is as a rule absorbed by the roots only; but in cases of excessive drought the leaves and green shoots can take it in. Experiments show that if some leaves are put in water, the cut end of the stem being in air, the shoot is not only kept alive for a time, but the buds in the axils of the leaves can shoot out, elongate into leafy branches, and bear flowers!

In the deserts near Cairo no rain falls during the greater part of the year; but certain plants keep perfectly green by absorption of dew, as in the Tamarix and a little herbaceous ally of the same family. These excrete salts (sodium and magnesium chlorides) by their leaves; which re-absorb water in the hottest period of the year.

We have seen how some plants are leafless, as the broom, so the duties of leaves are undertaken by the stem and branches, these duties being the absorption of carbonic acid gas from the air, retaining the carbon and ejecting the oxygen. It is this process of "assimilation" which keeps up the balance in the air; for all animals breathe *out* the deleterious gas called carbonic acid, and it is only the life of plants that has the power to separate the oxygen from the carbon—carbonic acid gas being composed of these two elements; then, by discharging the oxygen, the atmosphere becomes again purified for all kinds of life, for breathing comprises the taking in of oxgyen and the expiration of carbonic acid. All plants and animals *must* expire.

Again, if the blade of a leaf is utilised as a tendril, the stipules can become leaf-like and undertake the duties, as in peas. In galiums the stipules are leaflike, etc.

In some plants the petioles become flattened and so simulate leaves, as in Australian Acacias.

But the most important metamorphosis resides in

flowers. Every separate part of a flower, sepal, petal, stamen, and carpel, are (metaphorically) leaves; that is, the "germ," which normally develops into any one of these parts, might at any time become a true leaf. The green rose and other "foliaceous" flowers are cases where every organ is represented by a leaf. In the double cherry, a tree often grown, with numerous petals in the place of stamens, there are always two little leaves in the middle, representing two carpels.

Double flowers are usually due to the changes of stamens into petals, which are then multiplied, thereby carrying on to excess what took place when the first petals appeared, as explained in describing buttercups and waterlilies; and as the earliest known flowers had no white or brightly-coloured petals, there were probably no such insects as now come to visit them.

When various organs originated from one and the *same* primeval structure, as all the parts of a flower from a leaf, they are said to be "homologous" with it. If, however, two organs of the same form and use originated from *different* organs—as the tendril of a pea, derived from a leaf, and that of the vine, from a flowering branch—they are said to be "analogous," but not homologous.

VEGETABLE MULTIPLICATION.—Another and abundant method of adaptation of one organ in the place of another is what is called "Vegetative Multiplication," instead of, or in addition to, reproductive propagation by seed. We have seen cases on the runners of the strawberry and *Ranunculus repens*, etc., as well as on the long subterranean stems of grasses, sedges, etc., in sand.

In the Lesser Celandine we saw how "offsets" spring from the base of the stem, as well as pill-like corms from the axils of the leaves. Bulbs and bulbils abound in some Monocotyledonous families, as those of Lilies, Daffodils, Iris, etc. Swollen, water-storing internodes of tropical orchids are called pseudo-bulbs.

This vegetative process is invaluable in cultivation,

1 2 3 4

Scots Pine.

otherwise we should have to wait three or four years before we could get potatoes from seed.

Similarly in the floral world many flowers as Anemones are multiplied by underground stems, and Hyacinths by bulbs. The Dutch, who provide us with them, have a way of greatly increasing the supply, for naturally a bulb only produces two or three bulbils; but by scooping out the bottom of the bulb into a hollow, so that the thick scales are all cut through, or by slashing the bulbs below crosswise, numerous little bulbs appear on the cut edges. These, being stimulated by heat, grow at the expense of the nourishment in the cut scales, till they can be transplanted, and then continue to grow on their own account.

Certain plants, with rather fleshy leaves, can be propagated by their leaves, as mentioned in the case of the Lady's Smock, naturally; but fragments of Begonia leaves can be used for the purpose. A florist once gave a hundred pounds for a newly-introduced Begonia leaf alone!

THE RECEPTACULAR TUBE.—I have alluded to the receptacular tube and described it as an overgrowth from the main flower-stalk; but certain cases would require a little more detail, as sometimes they seem to show that the tube is formed by the cohesion of what may be said to represent the *stalks* of the sepals, etc., thickened and coherent. Thus, if a pear be cut down the middle the carpels are seen to originate above the end of the flower-stalk (not as in an apple); the fleshy part commencing below them and covering them up above. Now the question is, how much of this is receptacular or otherwise? Fig. 97 is an illustration of a malformed pear which seems to throw some light upon it. It will be observed how the *bases* of the now more or less separated petioles are swollen, so that they seem to make the suggestion that it is *they* that form the succulent part of the pear. It will be noticed that there are *three* abortive "pears" one over another. This is a common "freak," but they are not usually with the blades so well developed. One,

the central in front, has a longer petiole than the others; hence the swollen part below it *may be* often all receptacular. Such is more certainly the case in Fig. 98 of a monstrous rose; the leaf in front, and the one on the left (*st*), represent sepals and bear their coherent pair of stipules at the base of the leaf-stalk (*st*). Hence the tube out of which it arises *must be* receptacular in this case.

FIG. 97.—Malformed Pear.

Conversely, the foliaceous sepals of the Fuchsia (Fig. 99) seem to prove that the "superior" calyx of four sepals is due to the cohesion of their

FIG. 98.—Malformed Rose.

FIG. 99.—Malformed Fuchsia.

petioles, now entirely free and properly formed.

These curious cases raise various questions for ramblers to try and solve when they come across them. They are commoner, however, under cultivation than when the plants grow wild.

HOW PLANTS RESPOND TO STRAINS, ETC.—This is an interesting feature of plant life which ramblers may often have an opportunity of witnessing, if their attention be drawn to the subject. Tendrils have already been described by which plants can support themselves; the tendril, being acutely sensitive to touch, coils round anything of the nature of a suitable support. The rambler should look for the tendrils of the Bryony and observe how the revolving "crank" causes the long slender tendril to become coiled in opposite directions, thereby giving great strength and elasticity to it.

Trees exhibit remarkable growths in response to strains. Prop-roots have already been mentioned in the second Ramble. It may be added that since the primary root is always arrested in Monocotyledons, just as in aquatic Dicotyledons, all subsequent roots must issue from the stem. They come out at the nodes in ascending series, as may be seen in many walking-sticks made out of canes, *i.e.* small palm-stems, etc., for the root end is used as the handle. It is easily seen in the Indian corn when germinating and growing into a full-sized plant. Several tropical trees send out roots for supporting both the trunk and branches. The Mahogany and other tall trees make long "buttress" roots, flattened sideways; while the Banyan (*Ficus indica*), a kind of Fig, is continually emitting prop-roots from its branches, so that the tree can extend itself over a vast area.

Leaves show in the distribution of their mid-rib and veins, a perfect distribution, to prevent a blade from being broken across. On the other hand, the Banana, a Monocotyledon which has suffered degeneracy from its ancestral aquatic habit, has no strength in the blade, which is always lacerated into separate fragments by the wind.

According to the theory that flowers, as now existing, are the "definite results" of the "direct action" of the insects which visit them, the weight, say, of a humble-bee has to be supported. It has been seen how the corolla of *Duvernoia* (Fig. 6) is closely fitted to it to bear its entire weight and to furnish the bee with ridges for grappling. Now, we may regard "cohesion" of the sepals and petals as Nature's first step in giving stability and strength to the calyx and corolla. As the former has in many cases to assist in supporting the latter, we find that Nature frequently adds supportive rods, *i.e.* vascular cords, not in the original sepal. Thus in the Labiates, the calyx is composed of five sepals, but it will be remembered that additional ones are added, varying in number in different genera, presumably in correlation with the weight of the insects which visit them.

These few observations are only hints to the rambler to be on the look-out for any other cases which may come under his observation.

It is the same with fruits. For example, if a pear hang vertically, it is perfectly symmetrical at the stalk end; but if the stalk project at an angle from the shoots, then, as the pear grows and increases in weight, it hangs more and more vertically. When this is the case, the *tension* along the stalk is not in the same direction as the *weight*, and there will be a tendency to rupture at the base of the pear on the opposite side from the tree. Nature therefore builds a "hump" of a size proportionally in response to the strain.

LEAF-ARRANGEMENTS ON PHYLLOTAXIS.—As the object of these rambles is to instruct the rambler as to what to observe in plant life, nothing should be omitted from his gaze; and an interesting feature in plants is to see the different ways in which leaves stand upon the shoot which bears them. The curious feature is that they can conveniently be represented mathematically. They are arranged on two systems; either they are "opposite"

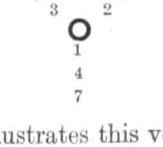
or "alternate" When two or more leaves are at the same joint and on exactly the same level, then the rule is that each pair will stand at right angles to the pairs above and below it. If there be three or four leaves at a node, then they too alternate in position with the whorls above and below.

When, however, a single leaf is at a joint all by itself, there is a much greater variety in the distribution; but it is all reducible to a simple system, called "alternate."

If we take a grass, an Iris, or a Gladiolus, it is easy to see that the leaves are in two ranks on opposite sides of the stem, but *not strictly* "opposite," in the sense of being *exactly* on the same level. They run thus—7, 5, 3, 1, ○ 2, 4, 6, 8, the ○ representing the stem.

As a circle contains 360°, Nos. 1 and 2 are at opposite ends of a diameter, 180° apart. If we draw a spiral line through the Nos. 1, 2, 3, 4, etc., up to 8, then the portion of the spiral from 1 to 3 makes a single coil or circle, embracing 360°. As there are *two* leaves in a *single* coil, it is represented by $\frac{1}{2}$. Botanists call this the "angular divergence," for it is also the number of degrees measured from the centre between any two consecutive leaves, *i.e.* $\frac{360}{2} = 180°$.

The next kind has three leaves in a coil or "cycle," as it is called. Thus—

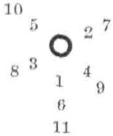


A Sedge (*Carex*) illustrates this very well.

The coil or cycle embraces the three leaves 1, 2, 3; 4, 5, 6; 7, 8, 9, etc. As three leaves only are required to complete one coil, the fraction $\frac{1}{3}$ will represent the arrangement, and $\frac{1}{3} \times 360° = 120°$, that is the number of degrees between any two successive leaves.

The next kind is the commonest among Dicotyledons It requires *two* coils embracing five leaves to make *one* cycle; thus leaves in succession will stand at an angular distance of $\frac{2}{5} \times 360 = 144°$.

They may be represented thus—1, 2, 3 does not complete a coil, but two coils require 4, 5 up to 6; but 6 begins a new cycle.



Now let us write down these fractions in succession— $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$; we see that the last may be got by adding the two numerators $1 + 1 = 2$, and the two denominators $2 + 3 = 5$. All succeeding kinds follow in the same way; so that they make up the series—

$\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, $\frac{13}{34}$, etc., *ad infinitum*.*

If we wish to study the arrangement of the scales on a fir-cone, we shall find they follow the same laws; but being very crowded, it is not possible to see at a glance which is No. 2, if we fix upon any scale as No. 1. It will, however, be observed how the scales run in parallel spirals, some to the right, others to the left. Now, first note the *most vertical row* (or as nearly vertical as possible); secondly, note the two spirals running in opposite directions and containing the two scales which *overlap* the one, *just*

* If any rambler happens to be a mathematician, he might draw a circle with a vertical diameter, putting 1 at the bottom to indicate the first leaf.

Then let him draw radii on one side at 180°, 120°, 144°, 135°, 137°+, corresponding to the position of the second leaf of the respective arrangements—$\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$. He will discover that they oscillate on either side of a certain position lying between 135° and 137°+. No leaf ever reaches that position, which is found by taking the sum of the entire series to infinity, which a mathematician can discover will be represented by $\frac{3 - \sqrt{5}}{2} \times 360 = 137° \; 30' \; 28''$.

above that selected as No. 1 in the vertical row. Revolve the cone and count the number of each of these—so-called—"secondary spirals." Take the *lowest* of the two numbers for the numerator and their *sum* for the denominator. This will be the fraction for the *whole* spiral which takes in *every scale*, in proper order, viz. Nos. 1, 2, 3, 4 . . . up to, say, 8 or 21; as the Scotch Fir is represented by $\frac{3}{8}$, and the Norway Spruce by $\frac{8}{21}$.

The object of all kinds of arrangements of leaves is to place the blade at right angles to the light which falls upon them; and they have various ways of effecting this. The following are a few for the rambler to notice, and he will probably soon discover others. If a shoot of the Common Laurel, which issues from the side of the bush, be examined, the leaves will be seen to be in two ranks or the $\frac{1}{2}$ plan, the whole of them being *horizontal* and in one plane. They thus all get light from the sky above alike. Now take a shoot arising *vertically* from the top of the bush, it will at once be seen that the leaves are arranged quite differently; they make five vertical rows of leaves, because they are now in the $\frac{2}{5}$ system; whereas on a horizontal shoot they are $\frac{1}{2}$.

The Yew manages differently. If a young shoot an inch or two in length be examined, the leaves are in a close spiral represented by $\frac{3}{8}$; but in the older and horizontal shoots they *appear* to be all in one horizontal plane, as in the Laurel. A close inspection, however, will show that the position of the leaves remains the same, but their little stalks have twisted, so as to make them horizontal.

This twisting of the petiole is often seen in shoots of bushes with opposite leaves, so as to bring them as nearly as possible into one line. Sometimes the *shoot* itself twists in growth so that a pair of leaves, normally at right angles to the next pair, may become exactly over it.

These are a few hints for observing the ways of plants with regard to the treatment of their leaves, which the rambler should take note of, as well as all the different

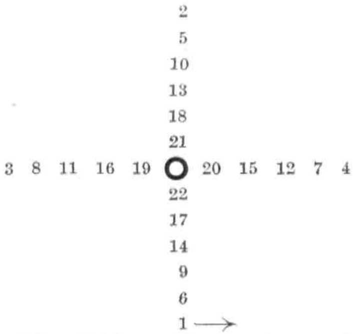
ways the young leaves behave in the opening bud in spring. The Lime (described above, p. 245), the Elm, Ash, Walnut, etc., all behave somewhat differently; thus, whereas the Walnut and the Ash put their leaves *vertically*, the former does so by their curving *downwards*, whereas in the Ash they curve *upwards*.

We must still take a step further backwards and see *why* $\frac{2}{5}$ is the commonest arrangement among Dicotyledons, and $\frac{1}{2}$ or $\frac{1}{3}$ those of Monocotyledons. We shall find that they arise out of differences in the number of Cotyledons.

If the rambler has an opportunity of examining a bed of Jerusalem Artichokes, he will soon find most, if not all, of the following varieties of arrangements :—

(1) All the leaves opposite ; (2) all the leaves in whorls of threes ; (3) opposite leaves below with alternate above ; (4) leaves in whorls of threes below with alternate above ; (5) all alternate on the $\frac{2}{5}$ plan.

It will be observed how the change from opposite to alternate is effected,* as shown in the accompanying diagram.† The numbers are placed *as if* the leaves had



* This often occurs in the Willow herbs (*Epilobium*) described above.

† If the reader will imagine the numbers to be on a spiral line, he will find that to reach No. 6 it requires *two* coils ; No. 9, *three* coils ; No. 14, *five* coils ; and No. 22, *eight* coils ; corresponding to the fractions $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$. Nos. 6, 9, 14 [17 = 2 × 8 + 1], 22 *begin* the next coils, and are not leaves of the preceding.

not changed their positions. They *begin* by making short internodes between the two leaves of each pair; at the same time they *shift* their positions, *i.e.* one no longer *grows out* exactly opposite the other; but the order of succession now recorded is *most important* to be observed, as indicated by the figure, which, it will be seen, would be on a spiral line if joined. The numbers 2, 4, 6 are, therefore, each a *little higher* than their companions, 1, 3, 5 respectively. Nor are they exactly opposite, having shifted their positions a short way along the spiral line.

After a time, however, they, so to say, settle down at a regular and constant angular distance of 144° apart, and the $\frac{2}{5}$ plan is completed.

As Dicotyledons always start with two *opposite cotyledons*, we thus see how the next leaves (unless they remain "opposite" too) pass readily into the $\frac{2}{5}$ plan, wherein the leaves become "alternate."

The $\frac{1}{2}$ plan, as we have seen, is commonest among Monocotyledons; but the $\frac{1}{3}$ and even higher members of the series are not unknown.

As there is only one cotyledon, the next may be at 180° or 160° from it; for (excepting $\frac{1}{2}$) any portion of the spiral which will make a circle, if *flat* like a watch-spring, *always* contains three leaves; so that Nature has the choice of making the first leaf opposite to the cotyledon (180°), as an Iris, or at an angular distance of 120°, *i.e.* the $\frac{1}{3}$ plan, as a Carex.

In flowers the latter arrangement has been adopted, and thus arose the ternary arrangement almost universal in the flowers of Monocotyledons.

Degeneracy a Cause of New Species.—We have seen how water deteriorates plants which live submerged; how they cannot develop their leaves fully, and so become "dissected"; also the primary root of the germinating plant is at once arrested. This degenerating effect may apply to the whole plant, so that when we compare it with allied species growing on land, we find they are often

"dwarfs" with smaller or narrower leaves than the land plant. Similarly the flowers may become degraded. We can illustrate this fact by plants taken from many different families. There is a little Crucifer called Awl-wort (*Subularia aquatica*) found in lakes in North Wales and Cumberland, etc. It is so called because the leaves are so small they resemble an awl. The whole plant is a little tuft of leaves, with a flower-stalk one to three inches. The flowers are one-tenth of an inch across with tiny white petals.

Water Blinks (*Montia fontana*) is comparatively common in brook-sides and marshes. It is a small annual and smooth herb. It is about one to five inches in height.

The flowers are minute, with white petals, the stamens being only three in number. The capsule is three-valved; when ripe they burst open, lie back, and the edges of the three valves (*i.e.* carpels) curl inwards, leaving three black, shiny seeds covered with protuberances. When the valves are thoroughly dry, they suddenly fly inwards and jerk the seeds out to a considerable distance.

We have discussed the purple Loosestrife, a plant growing to five feet in height, but a little aquatic plant of the same family is called the Water-Purslane (*Peplis Portula*). It grows to eight inches, with opposite leaves. The flowers are very minute and purplish. The petals are six, stamens six or twelve; the style is short. There are three species, but not with the three forms of styles and stamens as in the Loosestrife.

The Great Hairy Willow Herb, called Codlins and Cream by country-folk, is a water-side plant. It bears rose-purple flowers. Unlike most moisture-loving plants, it is not smooth, but densely hairy. It grows to five feet in height like the Loosestrife. There is also a small ally only ten inches high, very rare, however, being found in boggy pools in Sussex and Hants. The flowers, like the Willow Herbs, have only four petals when present, as in American species; but they are wanting in the British

one, which has no English name; its Latin name is *Ludwigia palustris*.

The next to be referred to belongs to the same family as the Foxglove and Snapdragon. It is called Mudwort (*Limosella aquatica*), and lives on the edges of ponds, being generally distributed over Scotland and England, but being a small tufted annual is probably overlooked. The corolla is nearly regular and bell-shaped ; the four stamens are characteristic.

We all know the large-leafed plantain; this has also a little aquatic ally, the Shore-weed (*Littorella lacustris*). The leaves are half cylindrical, and all radical, *i.e.* springing from the base of the stem in a rosette. The flowers have their whorls in fours, just as in plantains, except the pistil, which has only two carpels. The males and females are separate, but on the same plants. The Marsh Samphire (*Salicornea herbacea*) is a salt-marsh plant (Fig. 90), but this has been described under the Ramble by the Sea.

There is a whole family of aquatic plants which seem to be more or less degraded forms of the Willow Herb family, as the flowers have their sepals and petals two, four, or else none. We have three genera, the Mare's-tail (*Hippuris vulgaris* (Fig. 47)), the Water Milfoil (*Myriophyllum*, three species), and the Water Star-wort (*Callitriche*, two species). The leaves of the first are very narrow, one and a half inches long, with minute and very imperfect flowers.

The second has dissected submerged leaves, like the Water Crowfoot and similar flowers, often with the sexes separate. If the stem rises above the water, then the segments of the leaves are shorter and stiffer, just as described of the Water Crowfoot ; when it rises above the surface, the whole of the microscopic or anatomical structure changes at the water-level, all above it being at once in adaptation to an aërial existence.

The third has the leaves in a little rosette on the surface of the water. The flowers are still more degraded. The

male consists of one stamen only. The female, of a four-carpelled pistil.

As a familiar instance of very great degradation in water-plants, our four kinds of Duckweed (*Lemna*), floating on well-nigh every horse-pond, may be considered (Figs. 58, 59). There is no distinction between leaf and stem, the little "fronds" being a sort of fusion of the two, as if the degradation has carried them back to a primeval condition as prevailing in seaweeds and low types of flowerless plants. They have hair-like roots hanging down into the water, and multiply by budding at the side of the "thallus" (as shown in the Ivy-leaved species, Fig. 59), as these sort of things are called. The flowers consist of a bract with two divisions within, which are two stamens and a pistil. Botanists regard this as a degraded ally of the Arum family, which contains our Lords and Ladies (*Arum*), as well as the Sweet Flag (*Acorus*). While the smallest of our duckweeds is one-eighth of an inch across, there is a still smaller genus (*Wolffia*) only one-twentieth of an inch long. It is the smallest known flowering plant.

We have seen how degeneracies by water are recognised by botanists as specific characters; that is to say, a new species named and described by systematists has been the result of living in water, as *Ranunculus heterophyllus*. The Water Crowfoot is known by having submerged dissected leaves and also floating complete ones. Another recognised species is *R. trichophyllus*, which has no floating leaves, all being degenerate and dissected.

Other causes may have analogous effects; thus impoverished states of plants can arise from excessive drought on a poor soil, etc.; but many plants have been able to adapt themselves to such conditions and perpetuated themselves by heredity, notwithstanding the loss of parts of their flowers, as may be shown by Figs. 41, 95. Besides *Nardus stricta*, another grass, so characteristic both of boggy and dry parts of heath-land, *Molinia cœrulea*,

has a variety (one instead of two to three-flowered) called *depauperata*.

The same specific or varietal name is given to the Goldielocks (*Ranunculus auricomus*) when the flowers are defective, as in the number of petals. A species of Sedge (*Carex depauperata*) occurs in *dry* woods. As species of this genus generally prefer a watery soil, the drought may have been, and probably was, the cause which suggested the name.

Another cause of degeneracy is excessive cold. Thus, beyond the tree zone on mountains, trees may grow, but they remain stunted. Thus the Norway Spruce is only about four feet in height in the extreme limit of plant growth, and the dwarf Birch (*Betula nana*) is reduced to about one foot. High Alpine plants as well as Arctic and Antarctic are dwarfs; hence so many are suitable for our rockwork in gardens.

It must not, therefore, be supposed that Evolution always implies *progressiveness* from inferiority to superiority, as from a fish to an elephant; but what must be understood is, that new species depend upon *adaptiveness* and *persistence*. The changes may be *advanced* or *retrogressive* in structure; if the latter, it is because certain organs are no longer required, or can no longer be maintained; but the plant has succeeded in adapting itself to the new conditions, whether these be better or worse than those to which it had been accustomed.

Parasites and Saprophytes.—We have occasionally come across a parasite in our rambles, but a few words in addition may not be out of place. First, parasites are plants which attach themselves to others, called their host plants, by sending a kind of root or sucker deep into the tissues of the host whence they derive nourishment at the expense of it. This process produces degeneration, because, being no longer self-supporting or only partially so, they have no further use for green leaves, for these, as stated, derive the carbon required for building up their

structures from the air. Hence many parasites are colourless, or, if coloured, *not* green.

We have one whole family devoted to parasites, called Broom-rapes, for one species (*Orobanche major*) grows on the Broom, another, *O. minor*, attaches itself to many plants. The first grows to about two feet in height, the latter is much smaller. When this gets into a clover field it is very destructive. The shape of the corolla is much the same as the gaping, irregular form of the Yellow Rattle of the Foxglove family, and as that plant is partially parasitic with several allied plants, it is thought that the Orobanches are greatly degenerated members of the same family. Experiments proved that one, the Cow-wheat (*Melampyrum pratense*), which has green leaves, cannot assimilate equally well as others in consequence of its partial parasitism, so that this function has *begun* to disappear. It can live in the soil without being parasitic as well as parasitically. In addition it can be a saprophyte, viz. live on decayed vegetable matter, as rotten wood, leaves, etc. Some orchids in woods are saprophytes, as the Bird's-nest Orchis mentioned as growing in beech woods on the chalk.

The Coral-root (*Corallorhiza innata*) is another, a brown, leafless saprophyte living in boggy or sandy copses in East Scotland.

The Mistletoe, already referred to, is well known to be a very injurious parasite on many trees, the oak being the rarest kind of host. The root, having penetrated the bark and spread along the succulent "cambium" layer, properly destined to make new wood, then thrusts roots or "sinkers" down into the older wood and roots into the cortex, whence shoots arise into the air. It then absorbs water by the sinkers, and by dissolving the tissues lives on them. But as it produces green leaves it can also utilise the carbonic acid gas in the atmosphere.

The genus (*Viscum*) has thirty or more species, while

our single species (*V. album*) has produced several varieties. Such can only arise in consequence of variations in the nature of the host-trees and the climate. Thus in South Africa there are several species. One has very minute leaves, a feature common with many herbs in that excessively dry climate; one in Australia is densely woolly from a similar cause. Several members of the family are not parasitic at all, being shrubs and trees, showing that the parasitic habit is an acquired one, and now, of course, hereditary.

The Bird's-nest Orchid (*Neottia nidus avis*) illustrates a curious but apparently general case of parasitism by fungi. They attack the embryo, and when this grows the threads of the fungus penetrate every new root and internode of the rhizome or creeping stem of the orchid. This then produces an abundance of starch *beyond* the infected zone, the axillary buds being unable to develop until "tuberisation" has become more vigorous; and the final terminal shoot manages to develop itself into a stem with flowers.

The parasitic life now begins to wane, and the orchid, in revenge, lives *internally*, as a saprophyte, on the dead parasite! Tuberous roots of orchids are always infected, the fungus entering the roots as soon as they penetrate the soil, and "tuberisation" begins immediately afterwards.

The largest flower in the world belongs to a parasite. It is called *Rafflesia Arnoldii* (Fig. 100). It is found in Sumatra, one of the tropical islands of the East, and Java. The seed on germination attacks the roots of a kind of vine, and, when sufficiently nourished, forms a globular bud without any stem at all; the bud then bursts open into a flower, some three feet in diameter, of red colour. A coloured wax model, of the natural size, is to be seen in one of the museums in Kew Gardens.

Classification, *illustrated.*—As we have now gathered a large number of plants, we will try to fit them into their

places in the DIVISIONS and SUB-DIVISIONS of DICOTYLEDONS and MONOCOTYLEDONS, of which a tabular list was given in Ramble I.

POLYPETALÆ.—As stated, this means petals non-coherent or not united together. Examples seen were the Buttercup, Waterlily, Poppy; *Crucifers*, Violet, Mallow, Geranium; Roses, Loosestrife, *Umbellifers*, etc.

Of this list of examples we must separate the first

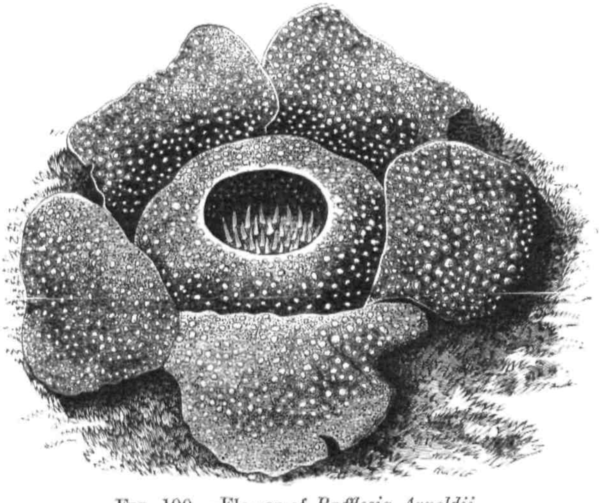


FIG. 100.—Flower of *Rafflesia Arnoldii.*

seven from the last three, because these fall under the second SUB-DIVISION. In the sub-division *Thalamifloræ* there is no *receptacular tube.* It is always to be found in the second: first as a sort of *dish*, as in the Strawberry and Blackberry; then as a *cup*, as in the Plum and Rose, but *quite free* from or *non-adherent* to the pistil within it. Finally, it may be *adherent* to the ovary, as in Apples, Willow-herb, Umbellifers and Ivy.

DIVISIONS II. or MONOPETALÆ means that all the

petals of the corolla are coherent, forming one piece. This may be without a receptacular-tube or with one adherent to the ovary; and then the calyx, corolla, and stamens *appear* to arise from the top of the ovary. Whenever this is the case, the ovary (as also in some of the CALYCIFLORÆ) is said to be "inferior" and the calyx is "superior." In THALAMIFLORÆ and others, where there is *no adherent* receptacular tube, the terms are reversed, the ovary is "superior" and the calyx "inferior," as in buttercup and poppy, or in pea and rose.

In the following the calyx is inferior, the corolla being in one piece, and the ovary superior:—Heath, Primrose, Privet, Borage, Deadnettle, Convolvulus, Foxglove, Verbena. The following have an "inferior" ovary, *i.e.* invested by the receptacular tube, so that the calyx is at the top as well as the corolla and stamens:—Honeysuckle, Bedstraw, *Composites, Campanula*, and the two genera of Heath-family containing the Bilberry, Cowberry, and Cranberry (*Vaccinium*).

The INCOMPLETÆ have fourteen British families, *e.g.* the Goosefoot, Dock, Mezereon, Spurge, Nettle, Mistletoe, Sweet-gale—the Catkin-bearing trees. The flowers are always defective in some way, and the question arises, are they due to degradation from ancestral corolla-bearing plants, to account for its universal absence; or are they types of primitive vegetation which never had corollas? Some were probably the latter. At least it may be suggested that the "cup-bearing" families, Willows and Poplars, as well as the Sweet-Gale, are ancestral types; but most, if not all, the others may probably be degraded forms; but the whole question is at present really insoluble.

DARWIN'S TWO EXPLANATIONS OF EVOLUTION.

I have repeatedly mentioned that plants, when germinating in a different soil and other conditions, *vary* as they

grow to maturity. If a number of seeds of the same kind grow together, *they all vary alike* in all essential features, or, as it is said, in *adaptation* to the new environment. One of the best examples is seen in an aquatic plant, such as the Water Crowfoot, when the water dries up and the seeds germinate on the mud. They all grow up alike, their whole internal anatomy altering so as to be now adapted to air, so that the site of the pond looks as if turfed over! How is the change wrought? Mere mud cannot do it. We have seen how water acts upon the protoplasm by saturating, and thereby weakening it, so that submerged leaves are *dissected* and imperfect in form; but the plant builds up its own tissues, which are not made for it by the water, or the mud and air. These supply what Darwin called "the Direct Action of the Conditions of Life," and the life in the plant *responds* to the influences, and then constructs new tissues, so as to become in adaptation to water or air as the case may be.

The potter moulds his clay to become a useful vessel, but the change of form is due to the *internal* power or "directivity" in the man acting *externally* on the clay. In the case of the plant, the "moulding" or, in other words, the construction of *internal* tissues to make the *external* form commence from *within* the plant. But the ultimate materials are as inanimate as clay. They consist of the elements of plant food taken up from the soil or air; and as clay requires *external* mechanical force, ruled by the potter so as to *direct* it in shaping the clay, so does *something within* the plant direct the physical forces to so move lifeless matter as to construct in the end marvellously perfect and adaptive structures.

Darwin described this process as the result of the "Definite Action of Changed Conditions of Life," or, as he says: "By this term, I mean an action of such a nature that, when many individuals of the same variety are exposed during several generations to any change in their physical conditions of life, all, or nearly all, the

individuals are modified in the same manner. A new sub-variety would thus be produced without the aid of selection." *

It may be noted that "many generations" may be required to "fix" the acquired characters; but the *actual change itself* begins the *very instant* that the plant experiences the change in its surroundings. Thus the dissected type of leaf, due to the response to the direct action of water, is now "fixed," as it is retained in air.

What did Darwin mean by "Selection"? His famous theory of *The Origin of Species by means of Natural Selection*, the title of his book published in 1859, explains it.

Starting with the same conditions as above, that a number of seeds of the same variety germinating under a new environment may *vary*, he *assumed* that instead of "all, or nearly all, varying alike," *i.e.* in adaptation to the surroundings, there were good and bad variations; and for "bad" he uses the word "injurious" variations of structure; *i.e.* "*inadaptive*." They, therefore, *must die* "suicidally," as we might say:—"This preservation of favourable [adaptive] individual differences and variations, and the [self] destruction of those which are injurious, I have called Natural Selection, or the Survival of the Fittest." †

He adopted the word "Selection" from breeders of cattle, and quotes Mr. Youatt, as saying of the principle of selection as "that which enables the agriculturalist, not only to modify the character of his flocks, but to change it altogether. It is the magician's wand, by means of which he may summon into life whatever form and mould he pleases." ‡ This, of course, is metaphorical.

Darwin cautions his readers that whether "selection" be used in breeding or in Nature, it is a purely *metaphorical*

* *The Variation of Animals and Plants under Domestication*, Vol. II., p. 271 (1868).

† *Origin of Species*, etc., 6th edition, p. 63

‡ *Ibid.*, p. 23.

expression; for the breeder *cannot himself* "modify" or "change" the character of his flocks. All he can do is to *select out of what Nature* has modified in response to the change of food, etc., which the breeder has supplied.

Darwin called this supposed collection of good and bad variations "Indefinite"; and compared Nature with the breeder by calling it "Natural Selection."

He seems, however, to have overlooked the fact that what he called "injurious," *i.e. inadaptive variations*, the existence of which is absolutely necessary for any so-called Natural Selection, *have never been seen;* no instance has had attention called to it. "Individual differences" are everywhere, for no two peas in a pod are absolutely alike, or leaves on a tree, but these are never injurious, and so kill the bearer. Any plant the cultivator pulls up, leaving those he selects, any sheep or oxen slain and not used for breeding, would have lived equally well as those selected.

So it is in the wild state. It is easy to see masses of seedlings come up near the parent plant, but if *isolated*, every one of them would grow. What kills off the majority is *not* any "injurious" thing *in an individual* itself, but it is because the earlier and therefore stronger seedlings starve them to death.

More than half a century has passed since Darwin's first theory was published. It was not till ten years afterwards (1868)that he strongly emphasised his other interpretation of evolution, which he barely alluded to in the first edition of the "Origin," in the words: "I am convinced that Natural Selection has been the main, but not exclusive, means of modification." * For he says: "Some slight amount of change may, I think, be attributed to the direct action of the conditions of life—as, in some cases, increased size from amount of food, colour from particular kinds of food or from light, and perhaps the thickness of fur from climate." †

* *Origin*, etc., 1st edition, *Introduction*, p. 6.
† *Op. cit.*, p. 11.

In the sixth edition of the *Origin*, etc. (1878, corrected to 1872) the alternative is enforced throughout the whole book. He admitted in a letter to Professor M. Wagner that: "In my opinion the greatest error which I committed, has been not allowing sufficient weight to the direct action of the environment—*i.e.* food, climate, etc.—independently of natural selection. When I wrote the 'Origin,' and for some years afterwards I could find little good evidence of the direct action of the environment; now there is a large body of evidence." *

The reader will see now that these two explanations of Evolution are *mutually exclusive*, for Natural Selection requires imaginary "injurious variations"; self-adaptation recognises none at all. In the first, plants or animals with injurious variations (by which Darwin always meant *inadaptive*, *not* malformations, diseases, etc.) *must die*; in the other, the majority of offspring perish, as he called it, by "fortuitous destruction," as by being crowded out by others in the struggle for existence. In the first, favourable variations arise, as Darwin says, by "accident," *i.e.* not by any natural law connecting them with the new environment. In the other, adaptive structures, which are *internal* as well as visibly *external*, anatomical as well as morphological, are *all* the result of adaptive response to the direct action of changed conditions of life; that power of response being an endowed property of Life, called Directivity of Life. As Sir Oliver Lodge says: "Life is a Director of Force."

* *Life and Letters of C. Darwin*, III., p. 159 (October 13, 1876).

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